QUALITY ASSURANCE PROJECT PLAN
Peninsula Boulevard Site
Hewlett, New York

Revision 6

Prepared for:
United States Environmental Protection Agency/Environmental Response Team
Edison, New Jersey

By:
Lockheed Martin/Scientific, Engineering, Response and Analytical Services
Work Assignment Number: SERAS-149

Based on the Intergovernmental Data Quality Task Force Uniform
Federal Policy for Quality Assurance Project Plans
(Final Version 1.1, June 2006)

November 10, 2015

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Site Name/Project Name: Peninsula Boulevard Site
Site Location: Hewlett, New York (NY)

Document Title: Quality Assurance Project Plan (QAPP) for Peninsula Boulevard Site – November 2015 through January 2106 Mobilization

Lead Organization: Environmental Protection Agency/Environmental Response Team (EPA/ERT)

Preparer's Name and Organizational Affiliation: Jean Bolduc, Lockheed Martin / Scientific, Engineering, Response and Analytical Services (SERAS)

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Preparation Date (Month/Day/Year): November 10, 2015

Investigative Organization's Project Manager/ Date: _____
Signature

Printed Name/Organization: Jeff Catanzarita/ERT Work Assignment Manager

Investigative Organization's Project QA Officer/Date: _____ 11/13/15
Signature

Printed Name/Organization: Stephen Blaze, ERT Quality Coordinator

Lead Organization's Project Manager/Date: _____ 11/17/15
Signature

Printed Name/Organization: Jean Bolduc/SERAS Task Leader

Approval Signatures/Date: _____ 11/10/15
Signature

Printed Name/Title: Deborah Killeen/SERAS QA/QC Officer

Approval Authority: SERAS

Other Approval Signatures/Date: _____ 11/10/15
Signature

Printed Name/Title: Kevin Taylor/SERAS Program Manager

Document Numbering System: SERAS-149-DQAPPR6-111015

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Peninsula Boulevard Site
Site Location: Hewlett, NY
Site Number/Code: 02TV
Operable Unit: OU-2
Contractor Name: Lockheed Martin
Contractor Number: EP-W-09-031

Contract Title: SERAS
Work Assignment Number: SERAS-149

1. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

2. Identify approval entity: US EPA/ERT

3. The QAPP is (select one): ☐ Generic ☒ Project Specific

4. List dates of scoping sessions that were held: 10/05/15

5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
QAPP for Peninsula Boulevard Groundwater Plume Site, Response Engineering and Analytical Contract (REAC) document #0309-DQAPP-051308	5/13/08
QAPP for Peninsula Boulevard, Hewlett, New York, SERAS document SERAS-149-DQAPP-120511	12/06/11
QAPP for Peninsula Boulevard, Hewlett, New York, SERAS document SERAS-149-DQAPPA1-060713	06/07/13
QAPP for Peninsula Boulevard, Hewlett, New York, SERAS document SERAS-149-DQAPPA2-031714	03/24/14
QAPP for Peninsula Boulevard, Hewlett, New York, SERAS document SERAS-149-DQAPPA3-092314	09/24/14
Revised QAPP for Peninsula Boulevard – January 2015 Mobilization, Hewlett, New York, SERAS document SERAS-149-DQAPPR4-012115	01/23/15
Revised QAPP for Peninsula Boulevard – April 2015 Mobilization, Hewlett, New York, SERAS document SERAS-149-DQAPPR5-042315	04/23/15

6. List organizational partners (stakeholders) and connection with lead organization:
EPA Region 2

7. List data users:
EPA Region 2

8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

Worksheet #37 – EPA Region 2 is responsible for the usability of the data

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QAPP Worksheet #3
Distribution List

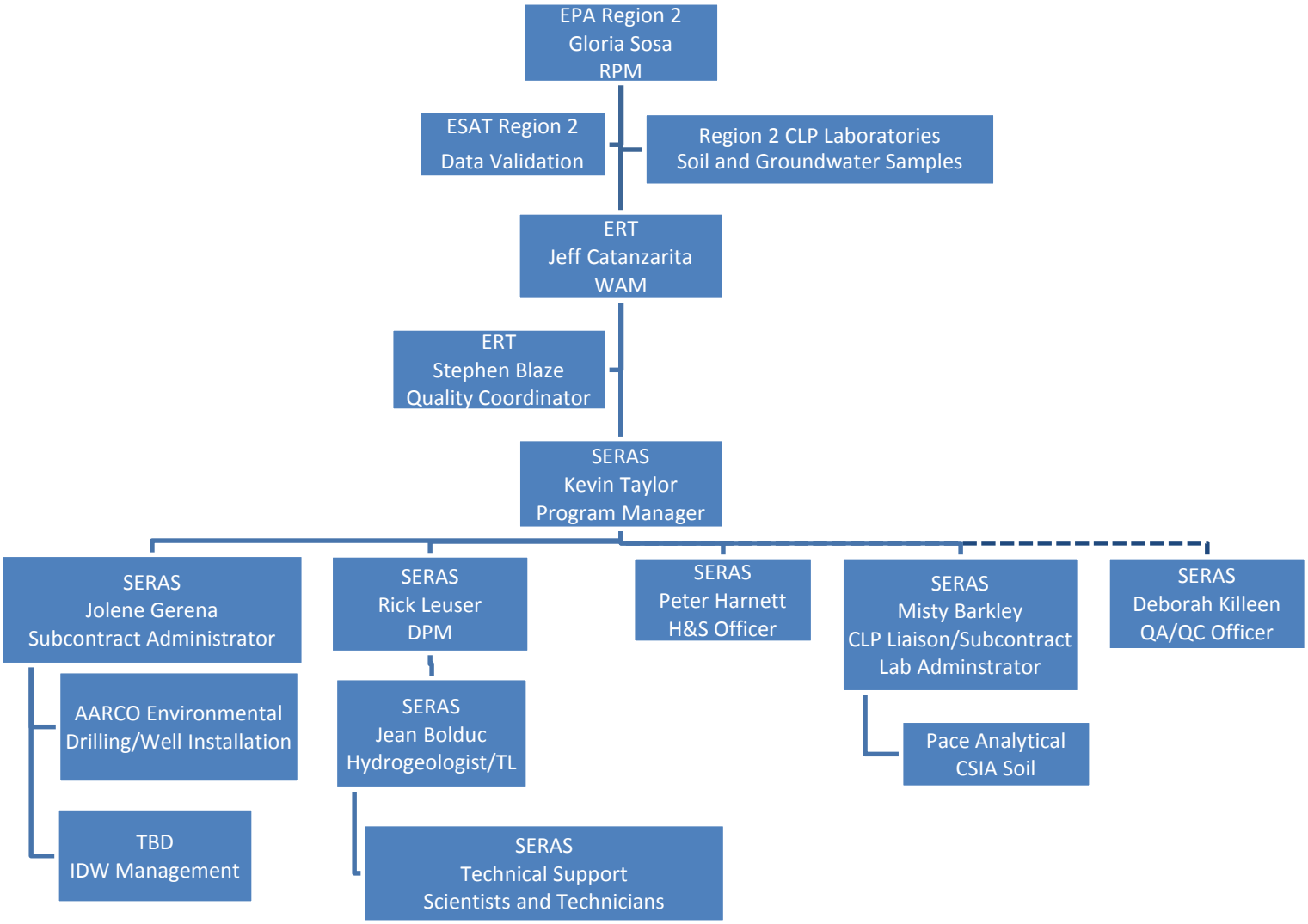
QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Jeff Catanzarita	Work Assignment Manager (WAM)	ERT	(732) 906-6929	(732) 321-6724	catanzarita.jeff@epamail.epa.gov	SERAS-149-DQAPPR6-111015
Stephen Blaze	Quality Coordinator	ERT	(732) 906-6921	(732) 321-6724	blaze.stephen@epamail.epa.gov	SERAS-149-DQAPPR6-111015
Gloria Sosa	Remedial Project Manager (RPM)	EPA Region 2	(212) 637-4283	(212) 637-3966	sosa.gloria@epamail.epa.gov	SERAS-149-DQAPPR6-111015
Jean Bolduc	Hydrogeologist/Task Leader (TL)	SERAS	(732) 321-4280	(732) 494-4021	jean.m.bolduc@lmco.com	SERAS-149-DQAPPR6-111015
Deborah Killeen	Quality Assurance/ Quality Control (QA/QC) Officer	SERAS	(732) 321-4245	(732) 494-4021	deborah.a.killeen@lmco.com	SERAS-149-DQAPPR6-111015
Richard Leuser	Deputy Program Manager (DPM)	SERAS	(732) 494-4060	(732) 494-4021	richard.m.leuser@lmco.com	SERAS-149-DQAPPR6-111015
Kevin Taylor	Program Manager	SERAS	(732) 321-4202	(732) 494-4021	kevin.c.taylor@lmco.com	SERAS-149-DQAPPR6-111015

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Organization: SERAS/EPA/ERT

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Jean Bolduc	SERAS Hydrogeologist/TL	(732) 321-4280		11/17/15
Jeff Catanzarita	ERT WAM	(732) 906-6929		11/17/15
Gloria Sosa	EPA RPM	(212) 637-4283		
Joe Policastri	SERAS Environmental Technician	(732) 321-4265		11-17-15
Christopher French	SERAS Environmental Technician	(732) 494-4040		
Scott Grossman	SERAS Environmental Scientist	(732) 321-4237		11/17/15

QAPP Worksheet #5
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Approval of initial QAPP and any amendments	ERT WAM ERT Quality Manager SERAS Program Manager SERAS QA/QC Officer SERAS TL	Jeff Catanzarita Stephen Blaze Kevin Taylor Deborah Killeen Jean Bolduc	(732) 906-6929 (732) 906-6921 (732) 321-4202 (732) 321-4245 (732) 321-4280	SERAS internal peer review, followed by ERT approval, implementation of changes effective only with approved QAPP or QAPP Change Form.
Nonconformance and Corrective Action	SERAS TL ERT WAM SERAS QA/QC Officer	Jean Bolduc Jeff Catanzarita Deborah Killeen	(732) 321-4280 (732) 906-6929 (732) 321-4245	Use of the Work Assignment Field Change Form for field issues.
Posting of Deliverables to the ERT Information Management System (IMS) website	SERAS TL SERAS QA/QC Officer SERAS Administrative Support SERAS Deputy Program Manager	Jean Bolduc Deborah Killeen Eileen Ciambotti Rick Leuser	(732) 321-4280 (732) 321-4245 (732) 321-4255 (732) 494-4060	As per work assignment, posting of deliverables to ERT-IMS website constitutes delivery to the WAM.
Work Assignment (WA)	SERAS Program Manager	Kevin Taylor	(732) 321-4202	Describes scope of work to SERAS personnel from the ERT WAM.
Health and Safety On-Site Meeting	SERAS TL and/or Site Health and Safety Officer	Jean Bolduc	(732) 321-4280	Describe potential site hazards, required personal protective equipment, and access to local emergency services.

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jean Bolduc	Hydrogeologist/TL	SERAS	Project Supervision/Subcontractor Oversight/Site Health and Safety Officer	Minimum BS degree plus 8 years related experience/LM Employee Files
Christopher French	Environmental Technician	SERAS	Field Activities/Sampling/Scribe	Environmental sampling experience/LM Employee Files
Joe Policastri	Environmental Technician	SERAS	Field Activities/Sampling	Environmental sampling experience/LM Employee Files
Scott Grossman	Environmental Scientist	SERAS	Field Activities/Sampling/Scribe	B.S. Biology, M.S. and 8 years plus of environmental experience/Lockheed Martin Employee Files
Mingling Li	Geographic Information System (GIS) Specialist	SERAS	GIS/Map Making	Minimum B.S. degree plus 3 years of related experience/Lockheed Martin Employee Files
Deborah Killeen	QA/QC Officer	SERAS	QA/Deliverable Review	Minimum BS degree plus 14 years related experience/ LM Employee Files
Kevin Taylor	Program Manager	SERAS	Program Oversight	Minimum B.S. degree plus 14 years of related experience/LM Employee Files
Peter Harnett	Health and Safety Officer	SERAS	HASP Review, PPE Selection, H&S Oversight	Minimum B.S. degree plus 14 years of related experience/LM Employee Files
Jeff Catanzarita	WAM	EPA/ERT	Technical Direction; Contract Laboratory Program (CLP) Coordination	EPA job-specific qualifications/In EPA files
Gloria Sosa	RPM	EPA Region 2	Technical Oversight	EPA job-specific qualifications/In EPA files
Stephen Blaze	Quality Coordinator	EPA/ERT	QA Oversight	EPA job-specific qualifications/In EPA files

HASP = health and safety plan
PPE = personal protective equipment
H&S = health and safety

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Project/Subcontractor Oversight	40 Hours + 8 Hr Annual Refresher Health & Safety Training	SERAS	Sept. 2016*	Jean Bolduc	TL/ Hydrogeologist/ SERAS	SERAS H&S Files
Field Activities	40 Hours + 8 Hr Annual Refresher Health & Safety Training	SERAS	Nov. 2015*	Scott Grossman	Environmental Scientist/SERAS	SERAS H&S Files
Field Activities	40 Hours + 8 Hr Annual Refresher Health & Safety Training	SERAS	June 2016*	Joe Policastri	Environmental Technician/ SERAS	SERAS H&S Files
Field Activities	40 Hours + 8 Hr Annual Refresher Health & Safety Training	SERAS	Nov. 2015*	Christopher French	Environmental Technician/ SERAS	SERAS H&S Files
QA Oversight	Uniform Federal Policy for Quality Assurance Project Plans	Advanced Systems	January 2006	Deborah Killeen	QA/QC Officer/SERAS	Quality Files

* Date training expires.

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Project Name: Peninsula Boulevard Site (WA# SERAS-149.4) **Projected Date(s) of Sampling:** Beginning 11/16/15 **Project Manager:** Jean Bolduc	**Site Name:** Peninsula Boulevard Site **Site Location:** Hewlett, NY

Date of Session: 10/05/15
Scoping Session Purpose: Discuss logistics and field/laboratory activities for the work assignment (continuation of the remedial investigation for OU-2).

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jean Bolduc	TL/Hydrogeologist	SERAS	732-321-4280	jean.m.bolduc@lmco.com	Task Leader
Jeff Catanzarita	ERT WAM	EPA/ERT	732-906-6929	catanzarita.jeff@epa.gov	Technical Direction

Comments/Decisions: The field activities will be conducted over more than one mobilization with the first mobilization scheduled for a 12-day period beginning November 16, 2015. A second mobilization will likely be required to complete the soil sampling and well installation activities and a third mobilization will likely be required for groundwater sampling. A Purchase Order will be placed with an outside vendor to provide a Geoprobe roto-sonic rig for soil sampling and monitor well installation. The soil cores will be field screened for volatile organic compounds (VOCs) using a photo-ionization detector (PID) and dense non-aqueous phase liquid (DNAPL) using an Oil-In-Soil shake test. Soil samples will be collected for VOC analysis at five-foot intervals in coarse-grained materials and at one-foot intervals from fine-grained materials below a depth of 30 feet in boreholes drilled to a maximum depth of approximately 100 feet. Soil samples will also be collected for VOC analysis from intervals with elevated PID readings at depths between 0 and 30 feet. The boreholes will be located at Cedarwood Cleaners, Piermont Cleaners, a vacant lot across West Broadway from Cedarwood Cleaners and in the boulevards along Hewlett Parkway adjacent to Cedarwood Cleaners and Hewlett Plaza adjacent to the vacant lot. At least 17 soil boreholes will be sampled during the first mobilization and additional boreholes may be sampled during a subsequent mobilization. Up to ten of the boreholes will be converted into groundwater monitor wells during the first mobilization and additional boreholes may be converted in monitor wells during a subsequent mobilization. All soil samples will be analyzed for VOCs at a Contract Laboratory Program (CLP) laboratory and a subset of the soil samples will be analyzed for grain-size distribution and total organic carbon (TOC) at the Region 2 laboratory. Up to four soil samples will be analyzed for 2-D (carbon and chloride isotopes for tetrachloroethylene [PCE] and trichloroethylene [TCE]) Compound Specific Isotope Analysis (CSIA) at a subcontract laboratory. Up to two samples of investigation-derived waste (IDW) soil may be collected and analyzed for characterization by a CLP laboratory using the Toxicity Characteristic Leaching Procedure (TCLP) for volatiles, semi-volatiles, herbicides, pesticides, and metals plus mercury. Up to two samples of IDW groundwater may be collected and characterized using VOCs analysis. A Purchase Order will be placed with an outside vendor for IDW management and disposal. Groundwater samples may be collected from newly installed monitor wells using passive diffusion bags or low flow methodology. The benchmarks for soil and groundwater are the same as previous mobilizations to the site.

Action Items: The owner of the vacant property will need to be added as additional insured on Lockheed Martin's insurance policy and the EPA will need to obtain an access agreement for that owner to drill and install wells on the property.

Consensus Decisions: The number of soil and groundwater samples will be determined in the field. An aqueous equipment blank will be collected at the end of the sampling program. Any soil and groundwater IDW samples will be submitted for analysis to a CLP laboratory.

Action Items: ERT will provide a list of addresses for underground utility mark outs that will be conducted prior to mobilizing to the site.

Consensus Decisions: The purpose of the sampling is to further characterize potential sources for the VOC plumes detected in soil and groundwater beneath the area. The assessment data generated during this mobilization will be used for engineering design of an applicable source remedy.

QAPP Worksheet #10
Problem Definition

The problem to be addressed by the project:
ERT in conjunction with US EPA Region 2 will be conducting one or more mobilizations to further delineate soil and groundwater VOC contamination detected during previous environmental investigations of the Peninsula Boulevard Site in Hewlett, NY. SERAS will subcontract an outside vendor to conduct Geoprobe roto-sonic drilling for soil sampling and monitor well installation at Cedarwood Cleaners, Piermont Cleaners, the vacant lot across from Cedarwood Cleaners on West Broadway, and the boulevards along Hewlett Parkway and Hewlett Plaza (Figures 1 and 2). SERAS will collect groundwater samples from the newly installed monitor wells. These activities will be conducted during an initial mobilization which is scheduled to begin in November 2015 and possibly a subsequent mobilization in early 2016.

The environmental questions being asked:
What is the nature and extent of the VOCs detected in the soil and groundwater at properties on the Peninsula Boulevard site?

Observations from any site reconnaissance reports:
The Peninsula Boulevard Groundwater Plume Superfund Site (Site) consists of the area within and around a groundwater plume located in the Village of Hewlett, Town of Hempstead, Nassau County, NY. The area consists of a mix of commercial and residential properties, with the majority of the commercial properties being located along Mill Road, Peninsula Boulevard, Broadway, and West Broadway.

A series of investigations and removal actions performed by the New York State Department of Environmental Conservation (NYSDEC) from 1991 to 1999 at the former Grove Cleaners site revealed an extensive groundwater contaminant plume extending both to the north and south of Peninsula Boulevard, primarily consisting of the chlorinated volatile organic compound PCE. The results of these investigations determined that operations at the former Grove Cleaners, located at 1274 Peninsula Boulevard from 1987 to 1992, resulted in the disposal of hazardous substances, including the VOCs PCE and TCE to the environment. In March 1991, the Nassau County Department of Health (NCDH) cited Grove Cleaners for discharging hazardous waste into on-site dry wells. PCE was detected in soil and sludge samples collected at the Grove Cleaners site and in other media at and near the property. The results of the investigation suggested the potential for additional source areas other than the former Grove Cleaners site. Following the implementation of interim remedial measures, which consisted of the removal of impacted soil related to solvent discharge to a dry well, a No Further Action remedy was selected by NYSDEC in March 2003 for the former Grove Cleaners site. On March 7, 2004, the EPA proposed inclusion of the site on the National Priorities List (NPL); on July 22, 2004, EPA placed the site on the NPL.

EPA conducted a Remedial Investigation (RI) at the Site from 2005 through 2010. Environmental sampling of groundwater, surface water, soil and sediment was performed and a Data Evaluation Report (DER) presenting the results of the environmental sampling was prepared in October 2008. Supplemental RI work was conducted in 2010 to address data gaps, including hydrogeological sampling and analyses, and to develop a baseline human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA). A DER Addendum was issued in December 2010 presenting the results of this sampling. An RI Report was released in June 2011. The RI identified groundwater contaminated with PCE, PCE-breakdown products, and low levels of other VOCs.

The source of the PCE groundwater contamination is suspected to be upgradient of the dry cleaning properties. To date, no viable Potentially Responsible Parties (PRPs) have been identified. However, previous environmental investigations conducted by SERAS in 2012 to 2015 at the dry cleaning properties and a vacant property detected soil and groundwater contamination.

A synopsis of existing data or information from site reports: Analytical results from soil vapor sampling conducted by SERAS in 2012 indicate that potential VOC contamination sources exist at three dry cleaners: Cedarwood Cleaners, Piermont Cleaners, and Former Vogue French Cleaners/Liberty Travel. A membrane interface probe hydraulic profiling tool (MiPHT) survey conducted by SERAS in 2013 indicated that Cedarwood Cleaners may be a primary source and Piermont Cleaners may be a secondary source of VOC contamination. Soil and groundwater samples collected in 2015 at a vacant property across West Broadway from Cedarwood Cleaners also contained high concentrations of VOCs.
The possible classes of contaminants and the affected matrices: VOC contamination of soil and groundwater. The target compounds of interest are primarily PCE and TCE.
The rationale for inclusion of chemical and nonchemical analyses: Previous environmental investigations conducted by SERAS detected VOC contamination of soil and groundwater at the Peninsula Boulevard site.
Information concerning various environmental indicators: The vertical extent of the VOCs contamination in the soil and groundwater has not been determined.
Project decision conditions ("If..., then..." statements): If VOC contamination is detected in the soil and groundwater samples, then the previous investigation results are verified and the data will be evaluated by EPA Region 2 to determine if additional assessment for delineation is needed. If VOC contamination is detected in the soil, then CSIA should be performed to possibly differentiate the PCE contribution from different sources. This mobilization is to further characterize the potential sources and their boundaries; therefore, the project action limits will be used to guide these activities.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

Who will use the data?
EPA Region 2

What will the data be used for?
The data will be used by EPA Region 2 to verify and further delineate previous findings of VOC contamination at the identified the dry cleaning properties, a vacant property and the boulevards along Hewlett Parkway and Hewlett Plaza.

What type of data is needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)
CLP laboratory analytical results for VOCs in soil and groundwater samples. EPA Region 2 laboratory analytical results for grain-size distribution and TOC. Subcontract laboratory analytical results for CSIA of soil samples. CLP analytical results for IDW soil and groundwater characterization. PID data for field screening VOCs in soil and shake test data for field screening DNAPL in soil. Global positioning system (GPS) data for site borehole locations. The drivers for this site will be PCE and TCE.

How "good" do the data need to be in order to support the environmental decision?
VOC analytical results for soil and groundwater; grain-size distribution and TOC analytical results for soil; and CSIA results for soil are definitive laboratory data. Analytical results for the IDW soil and water characterization are screening laboratory data. Worksheets #12, #28 and #28 show the measurement performance criteria that are needed for the quality indicators. Worksheet #20 outlines the field quality control sample requirements. GPS, PID, and shake test data are screening or semi-quantitative data.

How much data are needed? (number of samples for each analytical group, matrix, and concentration)
This is a continuation of the October 2014 and January/April 2015 field investigations. The total number of soil and groundwater samples will be determined in the field. Soil and groundwater samples will be collected from locations at Cedarwood Cleaners, Piermont Cleaners, a vacant lot across from Cedarwood Cleaners on West Broadway, and the boulevards along Hewlett Parkway and Hewlett Plaza. Soil samples will be collected from boreholes and groundwater samples will be collected from newly installed monitor wells located on those properties. All soil and groundwater samples will be analyzed for VOCs. A subset of the soil samples will be analyzed for grain-size distribution and TOC. Four soil samples, selected based on elevated PID readings, will be analyzed for chlorinated CSIA.

A maximum of two samples from soil cuttings and water generated during the drilling and monitoring well installation activities will be collected for waste characterization at the discretion of the WAM. The soil samples will be analyzed by a CLP subcontracted laboratory using the TCLP, EPA/SW-846 Method 1311 as an extraction method, followed by the appropriate EPA SW-846 analytical methods listed in Worksheets #15-3 through #15-7 for volatiles, semi-volatiles, pesticides, herbicides, and metals. The water samples will be analyzed by a CLP Laboratory for VOCs by the EPA analytical method listed in Worksheet #15-2.

Where, when, and how should the data be collected/generated?
Soil samples will be collected from the boreholes in a lined core barrel and groundwater samples will be collected from newly installed monitor wells using passive diffusion bags or low flow methodology. A Geoprobe roto-sonic rig will be used to access the soil for sampling and to drill boreholes that will be converted into groundwater monitor wells. Soil samples for VOC analysis will be collected at five-foot intervals in coarse-grained materials and at one-foot intervals in fine-grained materials encountered between depths of 30 feet to a maximum depth of 100 feet. A subset of those soil samples, selected based on changes in lithology or elevated PID readings, will be analyzed for grain-size distribution and TOC. Soil samples will only be collected from depths between 0 and 30 feet where elevated PID readings are detected. Four soil samples, selected based on elevated PID readings, will be analyzed for chlorinated CSIA. Analytical results will be generated for soil and groundwater samples. After the soil sampling and monitor well installation is completed, IDW samples will be collected for disposal characterization from soil cuttings contained in a roll-off bin and water contained in a frac tank.

Who will collect and generate the data?
Soil and groundwater samples will be collected by SERAS and relinquished to CLP, Division of Environmental Science and Assessment (DESA) EPA Region 2, and subcontract laboratories for analysis. Environmental Services Assessment Team (ESAT) will validate the CLP analytical results. GPS, PID, and shake test data will be collected by SERAS personnel. CSIA data will be generated by Pace Analytical and will be reviewed and used by EPA Region 2. Data generated by DESA will be reviewed in-house prior to submittal to the WAM.

How will the data be reported?
Validated CLP and reviewed DESA data for soil and groundwater samples and preliminary CLP data for IDW soil samples will be reported directly to the WAM and forwarded on to the SERAS TL. A final Trip Report, prepared in accordance with SERAS Standard Operating Procedure (SOP) #4017, *Preparation of Trip Reports*, will be the final deliverable to the EPA/ERT WAM. Data will be disseminated to EPA Region 2 by the ERT WAM.

How will the data be archived?
Hard copies of all deliverables will be stored in SERAS Central Files and e-copies will be stored on the SERAS local area network (LAN). Analytical results and GPS data will be imported into a Scribe database and posted to the ERT- IMS website. All deliverables will be archived by SERAS in accordance with Administrative Procedure (AP) #34, *Archiving Electronic Files*.

QAPP Worksheet 12-1
Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group	TCL Volatiles
Concentration Level	Low/Medium (ug/kg, ug/L)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOPs #2007 or #2012	SOM02.2	Precision (field)	± 35% PD for soil ± 20% RPD for aqueous	Field Duplicate	S & A
		Accuracy (field)	No analyte > CRQL*	Equipment (Field) Blank/Method Blank	S & A
		Precision (laboratory)	± 35% RPD for soil and ± 20% RPD for aqueous; List compound specific RPD	Field Duplicate; MS/MSD**	S & A; A
		Accuracy (laboratory)	List compound specific %R	***DMCs; MS/MSD**	A
		Completeness	> 90% water/soil sampling > 90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
*Reference USEPA Region 2 SOP No. 24/Low/Medium – Blank Type Criteria Table
**Optional MS/MSD – Reference CLP SOM02.2 Exhibit D, Table 6 for Criteria
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM02.2, Exhibit D, Table 5 for Criteria
RPD = Relative Percent Difference
CRQL = Contract Required Quantitation Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
%R = Percent Recovery

QAPP Worksheet 12-2
Measurement Performance Criteria Table

Matrix	IDW Soil
Analytical Group	TCLP Volatiles
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2009	EPA SW-846 Method 1311/8260C	Precision	RPD within laboratory control chart limits	Laboratory Duplicates	A
		Accuracy/Bias	%R ±30% or within laboratory control chart limits	Laboratory Control Sample (LCS)	A
		Precision (laboratory)	50-200% of area of Continuing Calibration (CCAL) or Mid Initial Calibration (ICAL)	Internal Standards	A
		Accuracy/Bias	%R = Within laboratory control chart limits	Surrogate Spike	A
		Accuracy/Bias	<RL	Method Blank	A
		Accuracy/Bias	%R = Within laboratory control chart limits	MS	S & A
		Sensitivity	Tune Criteria – See Table 3 of 8260C	Instrument Performance Check	A
		Completeness	>90% sampling completed >90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21-3
[2]Reference number from QAPP Worksheet #23-3
CCAL – continuing calibration
ICAL – initial calibration

QAPP Worksheet 12-3
Measurement Performance Criteria Table

Matrix	IDW Soil
Analytical Group	TCLP Semi-Volatiles
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2009	EPA SW-846 Method 1311/8270D	Precision	RPD Within laboratory control chart limits	Laboratory Duplicates	A
		Accuracy/Bias	%R ±30% or within laboratory control chart limits	LCS	A
			50-200% of area of CCAL or Mid ICAL	Internal Standards	A
			%R = Within laboratory control chart limits	Surrogate Spikes	A
			<RL	Method Blank	A
			%R = Within laboratory control chart limits	MS	S & A
		Sensitivity	Tune Criteria – See Table 3 of 8270D	Instrument Performance Check	A
		Completeness	>90% sampling completed >90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

QAPP Worksheet 12-4
Measurement Performance Criteria Table

Matrix	IDW Soil
Analytical Group	TCLP Herbicides
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2009	EPA SW-846 Method 1311/8151A	Precision	RPD Within laboratory control chart limits	Laboratory Duplicates	A
		Accuracy/Bias	%R ±30% or within laboratory control chart limits	LCS	A
			%R = Within laboratory control chart limits	Surrogate Spikes	A
			<RL	Method Blank	A
			%R = Within laboratory control chart limits	Matrix Spikes	S & A
		Completeness	>90% sampling completed >90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

QAPP Worksheet 12-5
Measurement Performance Criteria Table

Matrix	IDW Soil
Analytical Group	TCLP Pesticides
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2009	EPA SW-846 Method 1311/8081B	Precision	RPD Within laboratory control chart limits	Laboratory Duplicates	A
		Accuracy/Bias	%R ±30% or within laboratory control chart limits	LCS	A
			%R = Within laboratory control chart limits	Surrogate Spikes	A
			<RL	Method Blank	A
			%R = Within laboratory control chart limits	MS	S & A
		Completeness	>90% sampling completed >90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

QAPP Worksheet 12-6
Measurement Performance Criteria Table

Matrix	IDW Soil
Analytical Group	TCLP Metals
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2009	EPA/SW-846 Method 1311/6010C/7470A	Precision	±20% RPD	Laboratory Duplicates	A
		Accuracy/Bias	%R 80-120	LCS	A
			%R 75-125	MS	S & A
			<RL	Method Blank	A
			%R 80-120	Post Spike (ICP only)	A
			Percent Difference (%D) ±10%	Serial Dilution (ICP only)	A
		Completeness	>90% sampling completed >90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
ICP – Inductively Coupled Plasma

QAPP Worksheet 12-7
Measurement Performance Criteria Table

Matrix	Soil/Water
Analytical Group	Chlorinated Solvents
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
SERAS SOP #2012/2007	Pace Analytical Chlorinated 2-D CSIA	Precision	Standard deviation ≤ ± 0.5%	Triplicate Analysis	A
		Accuracy/Bias	± 1.00 per mil uncertainty	LCS_LO	A
			± 1.00 per mil uncertainty	LCS_HI	A
			<Method Detection Limit (MDL); if >MDL then area < 1 Vs	Method Blank	A
		Completeness	>90% sampling completed >90% laboratory analysis	Data Completeness Check	S & A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

QAPP Worksheet #13
Existing Data Criteria and Limitations Table

Existing Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Soil Gas and Groundwater Sampling Data	SERAS, Peninsula Boulevard Site, Hewlett, New York, February 2012 Soil Gas and Ground Water Sampling Work Assignment #SER00149 – Trip Report	SERAS, Definitive Data, Soil Gas and Groundwater Sampling Data, Collected February 6 to 10, 2012	The soil gas and groundwater sampling data will be used to identify MiHPT sampling locations at each of the three dry cleaner sites involved in this investigation.	None
MiHPT Survey Data	S2C2, Subsurface Characterization Using Membrane Interface Probe (MIP) With Heated Trunkline, Town of Hewlett, New York, July 19, 2013	S2C2, Inc., Screening Data, MiHPT data collected June 17 through 27, 2013	The MiHPT data will be used to identify soil borehole and groundwater monitor well locations for sampling at each of the three dry cleaner sites involved in this assessment.	None
Soil and Groundwater Sampling Data	SERAS, Peninsula Boulevard Site, Hewlett, New York, Draft Technical Memorandum, SERAS-0149-DTM-062415	SERAS, Definitive Data, Soil Gas, MiHPT, Soil and Groundwater Sampling Data, Collected from January 2012 through April 2015	Data will be used to guide the continuation of the delineation effort in 2015/2016.	None

QAPP Worksheet #14
Summary of Project Tasks

Sampling Tasks: SERAS personnel will collect soil samples (number to be determined by the WAM) in accordance with SERAS SOP #2012, *Soil Sampling*. SERAS personnel will collect groundwater samples (number to be determined by the WAM) in accordance with SERAS SOP #2007, *Groundwater Well Sampling* or in accordance with the EPA Region II *Ground Water Sampling Procedure, Low Flow (Low Stress) Purging and Sampling*. SERAS personnel will collect up to two samples of IDW soil from a roll-off bin for waste characterization using TCLP volatiles, semi-volatiles, pesticides, herbicides and metals and two samples of IDW water from a frac tank for VOCs analysis.
Analysis Tasks: Soil and groundwater samples will be analyzed for VOCs through the CLP. The standard CLP target analyte list will be used (see Worksheets #15-1 and #15-2). A subset of the soil samples will be analyzed for grain-size distribution and TOC through the EPA Region 2 DESA lab. Up to six soil samples will be analyzed for CSIA at Pace Analytical. Solid waste characterization samples will be analyzed through the CLP using TCLP, EPA/SW-846 Method 1311 as an extraction method, and appropriate EPA SW-846 analytical methods for volatiles, semi-volatiles, pesticides, herbicides, and metals (see Worksheet #23). The target analyte list will be comprised of the constituents listed in Table 1 of the TCLP Method. Aqueous waste characterization samples will be analyzed through the CLP for VOCs. Target analyte lists are presented for individual analytical groups in Worksheets #15-2 through #15-7.
Quality Control Tasks: SERAS will collect QC samples for the soil and groundwater sampling in accordance with EPA CLP guidelines or policies and SERAS SOP #2005, *Quality Assurance/Quality Control Samples.* Field QC samples are described on Worksheet #20 and analytical QC samples are listed on Worksheet #28. QC samples will not be collected for the waste characterization sampling.
Existing Data: Refer to Worksheet #13.
Data Management Tasks: All soil borehole and groundwater sample locations will be identified by a field assigned number. All soil, groundwater, and waste characterization samples will be identified by a CLP assigned number. All deliverables will be generated in accordance to the appropriate SERAS SOP and posted to the ERT-IMS website upon completion. Posting to the ERT-IMS site will be considered as completion of the deliverable.
Documentation and Records: All documentation will be recorded in accordance with SERAS SOP #4001, *Logbook Documentation*. The Trip Report will provide a description of the project; field methodologies and results, and will be prepared in accordance with SERAS SOP #4017, *Preparation of Trip Report*. Documents and records that may be generated during this project include: amended Work Plan (WP), revised QAPP, modified HASP, Scribe database, and Trip Report.
Assessment/Audit Tasks: No performance audit of field operations is anticipated for this project. The tasks associated with this revised QAPP are assessed using peer reviews and management system reviews. Peer review enables reporting errors to be corrected before reports are submitted. Management system reviews establish compliance with prevailing management structure, policies and procedures, and ensures that the required data are obtained.

Data Review Tasks:
All project deliverables will receive an internal peer review prior to release, per guidelines established in the SERAS AP #22, *Peer Review of SERAS Deliverables.*

Analytical data deliverables for CLP VOCs will be in accordance with the U.S. EPA CLP *Multi-Media Multi-Concentration Organic Analysis [SOM02.2].* The organic data will be validated according to U.S. EPA/DESA/HWSS SOP Number HW-33/ *Low/Medium Volatile Data Validation,* Revision 3 and SOP Number HW-34, *Trace Volatile Data Validation*.

Data validation will not be conducted for the soil waste characterization samples.

QAPP Worksheet 15-1
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: TCL Volatiles
Concentration Level: Low and Medium

Analyte	CAS Number	Project Action Limit NYSDEC 6NYCRR Part 375 (mg/kg)**	Project Quantitation Limit (mg/kg)	Analytical Method – SOM01.2 (Low) Quantitation Limits (mg/kg)	Analytical Method – SOM01.2 (Medium) Quantitation Limits (mg/kg)
Dichlorodifluoromethane	75-71-8	NS	0.005	0.005	0.25
Chloromethane	74-87-3	NS	0.005	0.005	0.25
Vinyl Chloride	75-01-4	0.02	0.005	0.005	0.25
Bromomethane	74-83-9	NS	0.005	0.005	0.25
Chloroethane	75-00-3	NS	0.005	0.005	0.25
Trichlorofluoromethane	75-69-4	NS	0.005	0.005	0.25
1,1-Dichloroethene	75-35-4	0.33	0.005	0.005	0.25
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NS	0.005	0.005	0.25
Acetone	67-64-1	0.05	0.01	0.01	0.5
Carbon Disulfide	75-15-0	NS	0.005	0.005	0.25
Methyl Acetate	79-20-9	NS	0.005	0.005	0.25
Methylene Chloride	75-09-2	0.05	0.005	0.005	0.25
trans-1,2-Dichloroethene	156-60-5	0.19	0.005	0.005	0.25
Methyl tert-Butyl Ether	1634-04-4	0.93	0.005	0.005	0.25
1,1-Dichloroethane	75-34-3	0.27	0.005	0.005	0.25
cis-1,2-Dichloroethene	156-59-2	0.25	0.005	0.005	0.25
2-Butanone (MEK)	78-93-3	0.12	0.01	0.01	0.5
Bromochloromethane	74-97-5	NS	0.005	0.005	0.25
Chloroform	67-66-3	0.37	0.005	0.005	0.25
1,1,1-Trichloroethane	71-55-6	0.68	0.005	0.005	0.25
Cyclohexane	110-82-7	NS	0.005	0.005	0.25
Carbon Tetrachloride	56-23-5	0.76	0.005	0.005	0.25
Benzene	71-43-2	0.06	0.005	0.005	0.25
1,2-Dichloroethane	107-06-2	0.02	0.005	0.005	0.25
1,4-Dioxane	123-91-1	0.1 (1)	0.100	0.100	5.0
Trichloroethene	79-01-6	0.47	0.005	0.005	0.25
Methylcyclohexane	108-87-2	NS	0.005	0.005	0.25
Bromodichloromethane	75-27-4	NS	0.005	0.005	0.25

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: TCL Volatiles-Continued
Concentration Level: Low and Medium

Analyte	CAS Number	NYSDEC 6NYCRR Part 375 (mg/kg)**	Project Quantitation Limit (mg/kg)	Analytical Method – SOM01.2 (Low) Quantitation Limits (mg/kg)	Analytical Method – SOM01.2 (Medium) Quantitation Limits (mg/kg)
1,2-Dichloropropane	78-87-5	NS	0.005	0.005	0.25
Toluene	108-88-3	0.7	0.005	0.005	0.25
trans-1,3-Dichloropropene	10061-02-6	NS	0.005	0.005	0.25
cis-1,3-Dichloropropene	10061-01-5	NS	0.005	0.005	0.25
4-Methyl-2-Pentanone	108-10-1	NS	0.01	0.01	0.25
1,1,2-Trichloroethane	79-00-5	NS	0.005	0.005	0.25
Tetrachloroethene	127-18-4	1.3	0.005	0.005	0.25
2-Hexanone	591-78-6	NS	0.01	0.01	0.5
Dibromochloromethane	124-48-1	NS	0.005	0.005	0.25
1,2-Dibromoethane	106-93-4	NS	0.005	0.005	0.25
Chlorobenzene	108-90-7	1.1	0.005	0.005	0.25
Ethylbenzene	100-41-4	1.0	0.005	0.005	0.25
o-Xylene	95-47-6	NS	0.005	0.005	0.25
m/p-Xylene	108-38-3/106-42-3	NS	0.005	0.005	0.25
Xylenes (total)	1330-20-7	0.26	0.005	0.005	0.25
Styrene	100-42-5	NS	0.005	0.005	0.25
Bromoform	75-25-2	NS	0.005	0.005	0.25
Isopropylbenzene	98-82-8	NS	0.005	0.005	0.25
1,1,2,2-Tetrachloroethane	79-34-5	NS	0.005	0.005	0.25
1,3-Dichlorobenzene	541-73-1	2.4	0.005	0.005	0.25
1,4-Dichlorobenzene	106-46-7	1.8	0.005	0.005	0.25
1,2-Dichlorobenzene	95-50-1	1.1	0.005	0.005	0.25
1,2-Dibromo-3-chloropropane	96-12-8	NS	0.005	0.005	0.25
1,2,4-Trichlorobenzene	120-82-1	NS	0.005	0.005	0.25
1,2,3-Trichlorobenzene	87-61-6	NS	0.005	0.005	0.25

**New York State Department of Environmental Conservation (NYSDEC), December 2006, 6 NYCRR Part 375 Environmental Remediation Programs, Subpart 375-6: Remedial Program Soil Cleanup Objectives (SCOs). Value listed from Table 375-6.8(a) for Unrestricted Use SCOs. The SCOs for unrestricted use were capped at a maximum value of 100 ppm. This value represents the lower of the restricted industrial SCO and the protection of ecological resources SCO.
(1) For constituents where the calculated SCO was lower than the contract required quantitation limit (CRQL), the CRQL is used as the Track 1 SCO value.
NS = not specified in **
mg/kg = milligrams per kilogram

QAPP Worksheet 15-2
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: TCL Volatiles
Concentration Level: Trace and Low

Analyte	CAS Number	Project Action Limits NYSDEC 6NYCRR Part 703 (ug/L)**	Project Quantitation Limit (ug/L)	Analytical Method – SOM01.2 (Trace) Quantitation Limits (ug/L)	Analytical Method – SOM01.2 (Low) Quantitation Limits (ug/L)
Dichlorodifluoromethane	75-71-8	5	0.5	0.5	5
Chloromethane	74-87-3	NS	0.5	0.5	5
Vinyl Chloride	75-01-4	2	0.5	0.5	5
Bromomethane	74-83-9	5	0.5	0.5	5
Chloroethane	75-00-3	5	0.5	0.5	5
Trichlorofluoromethane	75-69-4	5	0.5	0.5	5
1,1-Dichloroethene	75-35-4	5	0.5	0.5	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	5	0.5	0.5	5
Acetone	67-64-1	NS	5	5	10
Carbon Disulfide	75-15-0	60	0.5	0.5	5
Methyl Acetate	79-20-9	NS	0.5	0.5	5
Methylene Chloride	75-09-2	5	0.5	0.5	5
trans-1,2-Dichloroethene	156-60-5	5	0.5	0.5	5
Methyl tert-Butyl Ether	1634-04-4	NS	0.5	0.5	5
1,1-Dichloroethane	75-34-3	5	0.5	0.5	5
cis-1,2-Dichloroethene	156-59-2	5	0.5	0.5	5
2-Butanone (MEK)	78-93-3	NS	5	5	10
Bromochloromethane	74-87-5	NS	0.5	0.5	5
Chloroform	67-66-3	7	0.5	0.5	5
1,1,1-Trichloroethane	71-55-6	5	0.5	0.5	5
Cyclohexane	110-82-7	NS	0.5	0.5	5
Carbon Tetrachloride	56-23-5	5	0.5	0.5	5
Benzene	71-43-2	1	0.5	0.5	5
1,2-Dichloroethane	107-06-2	0.6	0.5	0.5	5
1,4-Dioxane	123-91-1	NS	100	-	100
Trichloroethene	79-01-6	5	0.5	0.5	5
Methylcyclohexane	108-87-2	NS	0.5	0.5	5
Bromodichloromethane	75-27-4	5	0.5	0.5	5

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: TCL Volatiles-Continued
Concentration Level: Trace and Low

Analyte	CAS Number	Project Action Limits NYSDEC 6NYCRR Part 703 (µg/L)**	Project Quantitation Limit (µg/L)	Analytical Method – SOM01.2 (Trace) Quantitation Limits (µg/L)	Analytical Method – SOM01.2 (Low) Quantitation Limits (µg/L)
1,2-Dichloropropane	78-87-5	1	0.5	0.5	5
Toluene	108-88-3	5	0.5	0.5	5
trans-1,3-Dichloropropene	10061-02-6	0.4	0.5	0.5	5
cis-1,3-Dichloropropene	10061-01-5	NS	0.5	0.5	5
4-Methyl-2-Pentanone	108-10-1	NS	5	5	10
1,1,2-Trichloroethane	79-00-5	1	0.5	0.5	5
Tetrachloroethene	127-18-4	5	0.5	0.5	5
2-Hexanone	591-78-6	NS	5	5	10
Dibromochloromethane	124-48-1	NS	0.5	0.5	5
1,2-Dibromoethane	106-93-4	NS	0.5	0.5	5
Chlorobenzene	108-90-7	5	0.5	0.5	5
Ethylbenzene	100-41-4	5	0.5	0.5	5
o-Xylene	95-47-6	5	0.5	0.5	5
m/p-Xylene	108-38-3/106-42-3	5	0.5	0.5	5
Xylenes (total)	1330-20-7	5	0.5	0.5	5
Styrene	100-42-5	5	0.5	0.5	5
Bromoform	75-25-2	NS	0.5	0.5	5
Isopropylbenzene	98-82-8	5	0.5	0.5	5
1,1,2,2-Tetrachloroethane	79-34-5	5	0.5	0.5	5
1,3-Dichlorobenzene	541-73-1	5	0.5	0.5	5
1,4-Dichlorobenzene	106-46-7	5	0.5	0.5	5
1,2-Dichlorobenzene	95-50-1	5	0.5	0.5	5
1,2-Dibromo-3-chloropropane	96-12-8	0.04	0.5	0.5	5
1,2,4-Trichlorobenzene	120-82-1	5	0.5	0.5	5
1,2,3-Trichlorobenzene	87-61-6	NS	0.5	0.5	5

**New York State Department of Environmental Conservation (NYSDEC), August 1999, 6 NYCRR Part 703 Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations. Value listed from Table 1 of Section 703.5 for Class GA waters and Health Water Source standards.
NS = not specified in **
µg/L = micrograms per liter.

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: IDW Soil
Analytical Group: TCLP VOCs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (mg/L)	Project Quantitation Limit (mg/L)	EPA Method 8260C Achievable Laboratory Limits		Achievable Laboratory Limits	
				MDLs	Method QLs (mg/L)	MDLs	QLs
2-Butanone	78-93-3	200	Lab-specific	NS	NS	Lab-specific	Lab-specific
1,1-Dichloroethene	75-35-4	0.70	Lab-specific	NS	NS	Lab-specific	Lab-specific
1,2-Dichloroethane	107-06-2	0.50	Lab-specific	NS	NS	Lab-specific	Lab-specific
1,4-Dichlorobenzene	106-46-7	7.5	Lab-specific	NS	NS	Lab-specific	Lab-specific
Benzene	71-43-2	0.50	Lab-specific	NS	NS	Lab-specific	Lab-specific
Carbon Tetrachloride	56-23-5	0.50	Lab-specific	NS	NS	Lab-specific	Lab-specific
Chlorobenzene	108-90-7	100	Lab-specific	NS	NS	Lab-specific	Lab-specific
Chloroform	67-66-3	6.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Tetrachloroethene	127-18-4	0.70	Lab-specific	NS	NS	Lab-specific	Lab-specific
Trichloroethene	79-01-6	0.50	Lab-specific	NS	NS	Lab-specific	Lab-specific
Vinyl Chloride	75-01-4	0.20	Lab-specific	NS	NS	Lab-specific	Lab-specific

*Project Action Limit = Regulatory level for the Toxicity Characteristic of a solid waste listed in 40 CFR 261.24
mg/L = milligrams per liter
NS = Not Specified

QAPP Worksheet #15-4
Reference Limits and Evaluation Table

Matrix: IDW Soil
Analytical Group: TCLP SVOCs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (mg/L)	Project Quantitation Limit (mg/L)	EPA Method 8270D Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs (mg/L)	MDLs	QLs
1,4-Dichlorobenzene	106-46-7	7.5	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
2,4,5-Trichlorophenol	95-95-4	400	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
2,4,6-Trichlorophenol	88-06-2	2.0	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
2,4-Dinitrotoluene	121-14-2	0.13	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Hexachlorobenzene	118-74-1	0.13	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Hexachlorobutadiene	87-68-3	0.50	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Hexachloroethane	67-72-1	3.0	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Nitrobenzene	98-95-3	2.0	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Pentachlorophenol	87-86-5	100	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Pyridine	110-86-1	5.0	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific
Total Cresols	NA	200	Lab-specific	NS	Lab-specific	Lab-specific	Lab-specific

*Project Action Limit = Regulatory level for the Toxicity Characteristic of a solid waste listed in 40 CFR 261.24
mg/L = milligrams per liter
NS = Not Specified
NA = Not Available

QAPP Worksheet #15-5
Reference Limits and Evaluation Table

Matrix: IDW Soil

Analytical Group: TCLP Pesticides

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (mg/L)	Project Quantitation Limit (mg/L)	EPA Method 8081B Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Chlordane	12789-03-6	0.030	Lab-specific	NS	NS	Lab-specific	Lab-specific
Endrin	72-20-8	0.020	Lab-specific	NS	NS	Lab-specific	Lab-specific
Heptachlor	76-44-8	0.008	Lab-specific	NS	NS	Lab-specific	Lab-specific
Heptachlor Epoxide	1024-57-3	0.008	Lab-specific	NS	NS	Lab-specific	Lab-specific
Lindane	58-89-9	0.040	Lab-specific	NS	NS	Lab-specific	Lab-specific
Methoxychlor	72-43-5	10.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Toxaphene	8001-35-2	0.50	Lab-specific	NS	NS	Lab-specific	Lab-specific

*Project Action Limit = Regulatory level for the Toxicity Characteristic of a solid waste listed in 40 CFR 261.24.
NS = Not Specified

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: IDW Soil

Analytical Group: TCLP Herbicides

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (mg/L)	Project Quantitation Limit (mg/L)	EPA Method 8151A Analytical Method		Achievable Laboratory Limits	
				MDLs (mg/L)	Method QLs	MDLs	QLs
2,4-D	94-75-7	10.0	Lab-specific	0.0002	NS	Lab-specific	Lab-specific
2,4,5-TP	93-72-1	1.0	Lab-specific	0.000075	NS	Lab-specific	Lab-specific

*Project Action Limit = Regulatory level for the Toxicity Characteristic of a solid waste listed in 40 CFR 261.24
NS = Not Specified
2,4-D = 2,4-Dichlorophenoxyacetic acid
2,4,5-TP = 2-(2,4,5-trichloro phenoxy) proprionic acid

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: IDW Soil

Analytical Group: TCLP Metals

Concentration Level: Low

Analyte	CAS Number	Project Action Limit * (mg/L)	Project Quantitation Limit (mg/L)	EPA Methods 6010C/7470A Analytical Method		Achievable Laboratory Limits	
				MDLs (mg/L)	Method QLs	MDLs	QLs
Arsenic	7440-38-2	5.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Barium	7440-39-3	100	Lab-specific	NS	NS	Lab-specific	Lab-specific
Cadmium	7440-43-9	1.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Chromium	7440-47-3	5.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Lead	7439-92-1	5.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Mercury	7439-97-6	0.2	Lab-specific	NS	0.0005	Lab-specific	Lab-specific
Selenium	7782-49-2	1.0	Lab-specific	NS	NS	Lab-specific	Lab-specific
Silver	7440-22-4	5.0	Lab-specific	NS	NS	Lab-specific	Lab-specific

*Project Action Limit = Regulatory level for the Toxicity Characteristic of a solid waste listed in 40 CFR 261.24
NS = Not Specified

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Soil/Water

Analytical Group: Chlorinated Solvents

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Analytical Method		Pace Analytical CSIA Achievable Laboratory Limits	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs* (µg/L)	QLs (µg/L)
Tetrachloroethylene	127-18-4	NS	1 ± 1 parts per mil uncertainty	NS	NS	1 ± 1 parts per mil uncertainty	NS
Trichloroethylene	79-01-6	NS	1 ± 1 parts per mil uncertainty	NS	NS	1 ± 1 parts per mil uncertainty	NS

*Method detection limit is defined as the signal size below which the standard deviation of the mean exceeds 0.5% and the $_{13}C$ values are outside the 0.5% interval around the running mean.
NS = Not specified

QAPP Worksheet #16
Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Quality Assurance Project Plan	SERAS	10/30/2015	11/09/2015	Revised QAPP	11/09/2015
Field Work	SERAS	11/16/2015	TBD	NA	NA
Soil & Groundwater Sample Analysis	CLP Laboratory	11/17/2015	TBD	Data Package	21 days after completion of analysis
Chlorinated 2-D CSIA Soil Sample Analysis	Pace Analytical	11/17/2015	1/17/2016	Data Package	2 months following sample receipt
IDW (Soil) Characterization Sample Analysis	CLP (Subcontracted) Laboratory	TBD	TBD	Data Package	21 days after completion of analysis
Soil and Groundwater Sample Data Validation	ESAT	TBD	TBD	Validation Report	21 days after completion of analysis
Draft Technical Memorandum	SERAS	Upon receipt of final data package	10 business days after receipt of CLP Final Data Package	Draft Technical Memorandum	10 business days after receipt of CLP Final Data Package
Final Technical Memorandum	SERAS	TBD	5 business days after receipt of WAMs comments on draft	Final Technical Memorandum	5 business days after receipt of WAMs comments on draft

TBD – To Be Determined

QAPP Worksheet #17
Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach): EPA Region 2 and ERT personnel will determine sampling locations at the properties during this mobilization and any subsequent mobilizations. All sampling will be judgmental and the sampling locations will be selected based on the presence of VOC concentrations detected in the soil and groundwater during previous environmental investigations at the site and based on observations made in the field. Please refer to the potential sampling locations in Figures 1 and 2.
Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) The delineation and source identification boreholes will be drilled to a maximum depth approximately 100 feet in the unconsolidated coarse-grained deposits of the Upper Glacial Aquifer at the properties. It is planned that 17 soil boreholes will be sampled during the first mobilization. Samples will be collected at 5-foot intervals until 30 feet is reached. After that point and up to 100 feet, samples may be collected at 1-foot intervals. Additional samples may be selected based on the PID readings. Up to 10 of the boreholes will be converted into groundwater monitoring wells. The number of soil and groundwater samples is TBD.

QAPP Worksheet #18
Survey Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates	Sampling SOP Reference[1]	Rationale for Sampling Location[2]
All/TBD (Contamination Delineation)	Soil	0-30 feet where elevated PID readings are detected; 30-100 feet at 5-foot intervals in coarse-grained materials and at 1-foot intervals in fine-grained materials	VOC TOC Grain Size CSIA	Low/Medium NA NA NA	TBD (field duplicates 1:20) NA NA NA	2012	Judgmental
All/TBD (Contamination Delineation)	Aqueous	Middle of screened interval in monitor well	VOC CSIA	Trace/Low NA	TBD (field duplicates 1:20) NA	2007 or EPA Region II Low Flow SOP	Judgmental

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #21)
[2]Refer to Worksheet #17

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	TCL Volatile Organics [CLP]	Low/Medium	SOM02.2	15 grams	(3) 5-gram EnCore®	Cool to ≤6°C	48 hours (from time of sample collection)
	Percent Moisture [CLP]	NA	SOM02.2	50 grams	(1) 4 oz. jar	NA	NA
	TOC	NA	EPA Region 2 SOP C-83	250 mL	1 x 4 oz. glass jar w/Teflon lined cap	Chemical: None Temperature: Cool to ≤6°C	28 days
	Grain size	NA	EPA Region 2 SOP Bio 8.3	100g (500g if gravel present)	1 x 16 oz. glass jar w/Teflon lined cap	Chemical: None Temperature: Cool to ≤6°C	NA
	CSIA	NA	Chlorinated 2-D CSIA	100g	3 x 4 oz. glass jar w/Teflon lined cap	Chemical: None Temperature: Cool to ≤6°C	3 months
Aqueous	TCL Volatile Organics [CLP]	Trace/Low	SOM02.2	120 mL	(3) 40 mL vials	Cool to ≤6°C °C pH <2 with 1:1 HCl	14 days
	CSIA	NA	Chlorinated 2-D CSIA	40 mL	12-40 mL VOA vials	Chemical: None Temperature: Cool to ≤6°C pH <2 with 1:1 HCl	14 days
Investigation-Derived Waste Soil	TCLP VOCs	Low	Prep: EPA SW-846 1311 Analysis: EPA SW-846 Method: 8260C	50 g	(2) 16-oz. clear wide-mouth glass jar w/ Teflon lined cap	Cool to ≤6°C	14 days (extraction), 14 days (analysis)
	TCLP SVOCs	Low	Prep: EPA SW-846 1311 Analysis: EPA SW-846 Method: 8270D	150 g			14 days (leachate prep.) 14 days (extraction), 40 days (analysis)
	TCLP Pesticides	Low	Prep: EPA SW-846 1311 Analysis: EPA SW-846 Method: 8081B	150 g			14 days (leachate prep.) 14 days (extraction), 40 days (analysis)

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference [1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
	TCLP Herbicides	Low	Prep: EPA SW-846 1311 Analysis: EPA SW-846 Method: 8151A				14 days (leachate prep.) 14 days (extraction), 40 days (analysis)
	TCLP Metals + Hg	Low	Prep: EPA SW-846 1311 Analysis: EPA SW-846 Method: 6010C/7470A	150 g			Mercury: 28 days (extraction/analysis) Other metals: 180 days (extraction/analysis)

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Trip Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Soil (Contamination Delineation)	VOC	Low/Medium	CLP SOM02.2	TBD	5%	NA	0	0	0	TBD
Soil (Contamination Delineation)	Grain size	NA	EPA Region 2 SOP Bio 8.3	TBD	0	0	0	0	0	TBD
Soil (Contamination Delineation)	TOC	NA	EPA Region 2SOP C-83	TBD	0	0	0	0	0	TBD
Aqueous (Contamination Delineation)	VOC	Trace/Low	CLP SOM02.2	TBD	5%	NA	TBD	2	0	TBD
Soil (Contamination Characterization)	CSIA	NA	Chlorinated 2-D CSIA	4	0	NA	0	0	0	4
Soil (Waste Characterization)	VOC	Low	EPA SW-846 Method 8260C	2	0	NA	0	0	0	2
Soil (Waste Characterization)	SVOC	Low	EPA SW-846 Method 8270D	2	0	NA	0	0	0	2
Soil (Waste Characterization)	Chlorinated Herbicides	Low	EPA SW-846 Method 8270D	2	0	NA	0	0	0	2
Soil (Waste Characterization)	Pesticides	Low	EPA SW-846 Method 8151A	2	0	NA	0	0	0	2
Soil (Waste Characterization)	Metals	Low	EPA SW-846 Method 6010C	2	0	NA	0	0	0	2
Soil (Waste Characterization)	Mercury	Low	EPA SW-846 Method 7470A	2	0	NA	0	0	0	2

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Trip Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Soil (Waste Characterization)	TCLP	NA	EPA SW-846 Method 1311	2	0	NA	0	0	0	2
Aqueous (Waste Characterization)	VOC	Trace/Low	CLP SOM02.2	2	0	NA	0	2	0	2
Aqueous	CSIA	Low	Chlorinated 2-D CSIA	4	0	NA	0	0	0	4

TBD - To Be Determined

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
2001	General Field Sampling Guidelines, Rev. 1.0, 06/07/13	SERAS	General Sampling		
2002	Sample Documentation, Rev. 0.0, 10/03/04	SERAS	General Sampling		
2003	Sample Storage, Preservation and Handling, Rev. 0.0, 08/11/94	SERAS	General Sampling		
2004	Sample Packing and Shipment, Rev. 1.0, 06/25/15	SERAS	General Sampling		
2005	Quality Assurance/Quality Control Samples, Rev. 0.0, 08/11/94	SERAS	General Sampling		
2006	Sampling Equipment Decontamination, Rev. 0.0, 08/11/94	SERAS	General Sampling		
2007	Groundwater Well Sampling, Rev. 1.0, 06/25/15	SERAS	General Sampling	Yes	In conjunction with EPA Region II low-flow sampling protocols
2012	Soil Sampling, Rev. 0.0, 07/11/01	SERAS	Sampling Equipment		
2074	Field Description of Soil and Sediment Borings, Rev. 1.0, 08/14/13	SERAS	Soil Sampling		
4001	Logbook Documentation, Rev. 0.0, 07/02/02	SERAS	Site Activities		
4005	Chain of Custody Procedures, Rev. 1.0, 10/31/01	SERAS	General Sampling		

http://www.epaosc.org/site/site_profile.aspx?site_id=2107

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment/ Instrument	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GeoExplorer 3000 Series Global Positioning System Receiver	None	Keep batteries charged	Field performance	Visual inspection	At time of use	Receives GPS satellite	Send to manufacturer for repair and calibration	SERAS	Manufacturer's manual
YSI 6920 Multi-Parameter Water Quality Meter	Calibration	Clean sensors or replace parts as needed	Perform calibration on all possible sensors (pH, conductivity, turbidity)	Inspect sensors for damage or wear	Calibrated by manufacter or rental company; to be calibrated by SERAS personnel only as needed	As per manufacture r instruction	Re-calibrate or return to rental company for repair or replacement	SERAS	SERAS SOP #2041
MultiRAE Pro 10.6eV PID	Zero and Span	Clean PID sensor and lamp as needed	Bump test	Visual inspection	Monthly and/or before each use	+/- 10%	Check gas concentration. Recalibrate, or clean sensor and lamp and recalibrate	SERAS	SERAS SOP #2139

[1]Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21)
http://www.epaosc.org/site/site_profile.aspx?site_id=2107

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
CLP SOM02.2	USEPA Contract Laboratory Program Statement of Work for Multi-Media, Multi-Concentration Organic Analysis; October 2006	Definitive	VOC	GC/MS	CLP	No
EPA Region II SOP C-83	SW- 846/9060	Definitive	TOC	NA	Region 2 Laboratory	No
EPA Region II SOP Bio 8.3	ASTM D422-63	Definitive	Grain size	NA	Region 2 Laboratory	No
Chlorinated 2-D CSIA SOP	Chlorinated 2-D Compound Specific Isotope Analysis	Definitive	CSIA	GC/IRMS	Pace Analytical	No
EPA/SW-846 Method 8260C	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) or equivalent	Screening	VOCs	GC/MS	Region 2 Assigned Laboratory	No
EPA/SW-846 Method 8270D	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) or equivalent	Screening	SVOCs	GC/MS	Region 2 Assigned Laboratory	No
EPA/SW-846 Method 8151A	Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation Derivatization or equivalent	Screening	Herbicides	GC/ECD	Region 2 Assigned Laboratory	No
EPA/SW-846 Method 8081B	Organochlorine Pesticides by Gas Chromatography or equivalent	Screening	Pesticides	GC/ECD	Region 2 Assigned Laboratory	No
EPA/SW-846 Method 6010C	Inductively Coupled Plasma-Atomic Emission Spectrometry or equivalent	Screening	Metals	ICP-AES	Region 2 Assigned Laboratory	No
EPA/SW-846 Method 7470A	Mercury in Liquid Waste	Screening	Metals	CVAA	Region 2 Assigned Laboratory	No
EPA/SW-846 Method 1311	Toxicity Characteristic Leaching Procedure	NA	TCLP Extraction	NA	Region 2 Assigned Laboratory	No

ICP-AES = inductively coupled plasma – atomic emission spectroscopy
CVAA = cold vapor atomic absorption
http://www2.epa.gov/clp
http://www3.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/MS	See SOM02.2	Initial calibration: upon award of the contract, whenever the laboratory takes corrective action which may change or affect the initial calibration criteria (e.g., ion source cleaning or repair, column replacement, etc.), or if the continuing calibration acceptance criteria have not been met. Continuing calibration: Once every 12 hours	Initial calibration/ Continuing calibration: relative response factor (RRF) greater than or equal to minimum acceptable response factor listed in Table 5 of procedure; %RSD must be less than or equal to value listed in Table 5 of procedure.	Initial calibration: inspect system for problems (e.g., clean ion source, change the column, service the purge and trap device), correct problem, re-calibrate. Continuing calibration: inspect system, recalibrate the instrument, reanalyze samples.	EPA CLP RAS Laboratory GC/MS Technician	SOM02.2
GC/MS	Refer to EPA SW-846 Method 8260C	Initial calibration: upon award of the contract, whenever major instrument maintenance or modification is performed or if the calibration verification technical acceptance criteria have not been met. Calibration verification: Once every 12 hours	Initial calibration/ Continuing calibration: relative response factor (RRF) greater than or equal to minimum acceptable response factor listed in procedure; %RSD must be less than or equal to value listed in procedure	Initial calibration: inspect system for problems (e.g., clean ion source, change the column, service the purge and trap device), correct problem, re-calibrate. Continuing calibration: inspect system, recalibrate the instrument, reanalyze samples.	Laboratory GC/MS Analyst	EPA SW-846 Method 8260C

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/MS	Refer to EPA SW-846 Method 8270D	Initial calibration: upon award of the contract, whenever major instrument maintenance or modification is performed or if the calibration verification technical acceptance criteria have not been met. Calibration verification: Once every 12 hours	Initial calibration/ Continuing calibration: relative response factor (RRF) greater than or equal to minimum acceptable response factor listed in procedure; %RSD must be less than or equal to value listed in procedure	Initial calibration: inspect system for problems (e.g., clean ion source, change the column, service the purge and trap device), correct problem, re-calibrate. Continuing calibration: inspect system, recalibrate the instrument, reanalyze samples.	Laboratory GC/MS Analyst	EPA SW-846 Method 8270D
GC/ECD	Refer to EPA SW-846 Method 8081B	Initial calibration: upon award of the contract, whenever major instrument maintenance or modification is performed or if the calibration verification technical acceptance criteria have not been met. Calibration verification: Once every 12 hours	Initial calibration/Calibration verification: resolution between two adjacent peaks must be greater than or equal to 60.0 percent, single components must be greater than or equal to 90.0 percent resolved, RTs within the RT window, %D must be within -20 percent, %RSD must be less than or equal to 20.0 percent.	Initial calibration: inspect the system (e.g., change the column, bake out the detector, clean the injection port) , correct problem, re-calibrate. Calibration verification: inspect system, recalibrate the instrument, reanalyze samples.	Laboratory GC/ECD Analyst	EPA SW-846 Method 8081B

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/ECD	Refer to EPA SW-846 Method 8151A	Initial calibration: upon award of the contract, whenever major instrument maintenance or modification is performed or if the calibration verification technical acceptance criteria have not been met. Calibration verification: Once every 12 hours	Initial calibration/Calibration verification: RTs within the RT window, %D must be within -15 percent, %RSD must be less than or equal to 20.0 percent.	Initial calibration: inspect the system (e.g., change the column, bake out the detector, clean the injection port) , correct problem, re-calibrate. Calibration verification: inspect system, recalibrate the instrument, reanalyze samples.	Laboratory GC/ECD Analyst	EPA SW-846 Method 8151A
ICP-AES	Refer to EPA SW-846 Method 6010C	ICP-AES Initial calibration: daily or once every 24 hours and each time the instrument is set up. ICP-AES Continuing calibration: beginning and end of run and frequency of 10% or every 2 hours during an analysis run.	ICP-AES: As per instrument manufacturer's recommended procedures, with at least 2 standards.	ICP-AES: inspect the system, correct problem, re-calibrate, and reanalyze samples.	Laboratory ICP-AES Analyst	EPA SW-846 Method 6010C
CVAA (Mercury)	Initial 5-point, ICV/CCV after every 10 samples	Each day of use	r>0.995 (initial), ICV = ±10%, CCV = ±10%	Perform maintenance, rerun calibration	Hg Analyst	SW-846 Method 7470A

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/IRMS	IS automatically injected into IRMS using multiple pulses. IRMS linearity check.	Daily calibration prior to sample analysis. Daily linearity check.	Linearity check – no correlation between peak area and measured isotopic ratio; slope < 0.2	Re-calibrate; re-analyze	Laboratory Assigned Analyst	Chlorinated 2-D CSIA SOP

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23)

QAPP Worksheet #25
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable re-calibration; see SOM02.2 or EPA Method 8260C or EPA Method 8270D	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA CLP RAS Laboratory GC/MS Technician/ Laboratory GC/MS Analyst	SOM02.2 SW-846 Method 8260C SW-846 Method 8270D
GC/ECD	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable re-calibration; see 2 EPA Method 8081B or EPA Method 8151A	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA CLP RAS Laboratory GC/ECD Technician/ Laboratory GC/ECD Analyst	SW-846 Method 8081B SW-846 Method 8151A
GC/IRMS	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable re-calibration; see Chlorinated 2-D CSIA SOP	Inspect the system, correct problem, re-calibrate and/or reanalyze samples	Pace Analytical GC/IRMS Technician/ Laboratory GC/IRMS Analyst	Chlorinated 2-D CSIA SOP
ICP-AES, CVAA	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable re-calibration; EPA Method 6010C/7470A, 7471B	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA CLP RAS Laboratory ICP-AES / ICP-MS Technician	EPA Method 6010C EPA Method 7470A

[1]Specify the appropriate reference letter or number from Analytical SOP References table (Worksheet #23)

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization: SERAS personnel
Sample Packaging (Personnel/Organization: SERAS personnel
Coordination of Shipment (Personnel/Organization): SERAS personnel
Type of Shipment/Carrier: Overnight delivery service or courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodian at designated laboratory
Sample Custody and Storage (Personnel/Organization): Sample Custodian at designated laboratory
Sample Preparation (Personnel/Organization): CLP, DESA EPA Region 2, and Pace Analytical sample technicians
Sample Determinative Analysis (Personnel/Organization): CLP, DESA EPA Region 2, and Pace Analytical sample technicians
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples to be shipped on day of collection and arrive at laboratory within 24 hours (1 day) of collection
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As per analytical method
Biological Sample Storage (No. of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: CLP, DESA EPA Region 2, and Pace Analytical sample technicians
Number of Days from Analysis: Per CLP guidelines

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Chain of custody records will be generated for all samples submitted for analysis per SERAS SOP #4005, *Chain of Custody Procedures*. Each sample will be individually labelled, then sealed with custody seals. Sample containers will be placed into Ziploc™ storage bags and then into a shipping cooler with the corresponding COC record. Samples will be shipped to the appropriate laboratory via overnight delivery service or courier. Refer to US EPA Office of Solid Waste and Emergency Response (OSWER) 924.0-44, EPA 540-R07-06 *Contract Laboratory Program Guidance for Field Samplers*, July 2007. EPA/ERT Scribe software will be used for sample management, as well as, generation of sample documentation, such as, labels and COC records. All COC records will be peer reviewed prior to shipment of samples in accordance with SERAS SOP # 4005, *Chain of Custody Procedures.* Samples will be shipped within 48 hours of sampling for next-day delivery under COC to the appropriate laboratory in accordance with SERAS SOP #2004, *Sample Packaging and Shipment.* Procedures outlined in SOP #2002, #2003, and #2004 will be applied (refer to Worksheet #21).
Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal): A sample custodian at the laboratory will accept custody of the shipped samples, and check them for discrepancies, proper preservation, integrity, etc. If noted, issues will be forwarded to the laboratory manager for corrective action. The sample custodian will relinquish custody to the appropriate department for analysis. At this time, no samples will be archived at the laboratory.
Sample Identification Procedures: Sample identifications will conform to SERAS SOP #2002, *Sample Documentation*. Each soil, groundwater, and waste characterization sample will be identified with a unique CLP identification number provided by the EPA Region 2 Regional Sample Center Control (RSCC) for analysis. The appropriate CLP sample number will be listed on the label of every sample container collected at a given location. The sample numbers will be entered in the site EPA/ERT Scribe database.
Chain-of-custody Procedures: Refer to SERAS SOP #4005, *Chain of Custody Procedures*

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Target Compound List Volatile Organics
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	SERAS SOP #2012
Analytical Method/SOP Reference	SOM02.2
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Method Blank	1 every 12 hours	No analyte > CRQL*		Suspend analysis unit source recertified	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*	
Matrix Spike (Not Required)	1 per ≤ 20 samples; if requested	1,1-Dichloroethene	59-172 %R	Flag outliers	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene	59-172 %R
		Trichloroethene	62-137 %R				Trichloroethene	62-137 %R
		Benzene	66-142 %R				Benzene	66-142 %R
		Toluene	59-139 %R				Toluene	59-139 %R
		Chlorobenzene	60-133 %R				Chlorobenzene	60-133 %R
Matrix Spike Duplicate (Not Required)	1 per ≤ 20 samples; if requested	1,1-Dichloroethene	0-22 %RPD	Flag outliers	EPA CLP RAS Laboratory GC/MS Technician	Precision	1,1-Dichloroethene	0-22 %RPD
		Trichloroethene	0-24 %RPD				Trichloroethene	0-24 %RPD
		Benzene	0-21 %RPD				Benzene	0-21 %RPD
		Toluene	0-21 %RPD				Toluene	0-21 %RPD
		Chlorobenzene	0-21 %RPD				Chlorobenzene	0-21 %RPD

*with the exception of methylene chloride, 2-butanone & acetone which can be up to 2 times the CRQL. (USEPA CLP Nat'l Functional Guidelines, Final, July 2007)

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Target Compound List Volatile Organics - Continued
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	SERAS SOP #2012
Analytical Method/SOP Reference	SOM02.2
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**		**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**	
Deuterated Monitoring Compounds	all samples	Vinyl chloride-d3	68-122 %R	Check calculations and instruments, reanalyze affected samples up to 3 DMCs per sample may fail to meet necessary limits (Section 11.3.4, Page D45/SOM01.2)	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	Vinyl chloride-d3	68-122 %R
		Chloroethane-d5	61-130 %R				Chloroethane-d5	61-130 %R
Deuterated Monitoring Compounds [cont'd]	all samples	1,1-Dichloroethene-d2	45-132 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet necessary limits (Section 11.3.4, Page D45 of SOM01.2)	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene-d2	45-132 %R
		2-Butanone-d5	20-182 %R				2-Butanone-d5	20-182 %R
		Chloroform-d	72-123 %R				Chloroform-d	72-123 %R
		1,2-Dichloroethane-d4	79-122 %R				1,2-Dichloroethane-d4	79-122 %R
		Benzene-d6	80-121 %R				Benzene-d6	80-121 %R
		1,2-Dichloropropane-d6	74-124 %R				1,2-Dichloropropane-d6	74-124 %R
		Toluene-d8	78-121 %R				Toluene-d8	78-121 %R
		trans-1,3-Dichloropropene-d4	72-130 %R				trans-1,3-Dichloropropene-d4	72-130 %R
		2-Hexanone-d5	17-184 %R				2-Hexanone-d5	17-184 %R
		1,4-Dioxane-d8	50-150 %R				1,4-Dioxane-d8	50-150 %R
		1,1,2,2-Tetrachloroethane-d2	56-161 %R				1,1,2,2-Tetrachloroethane-d2	56-161 %R

QAPP Worksheet #28-1
QC Samples Table

Matrix	Soil
Analytical Group	Target Compound List Volatile Organics - Continued
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	SERAS SOP #2012
Analytical Method/SOP Reference	SOM02.2
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Deuterated Monitoring Compounds [cont'd]	all samples	1,2-Dichlorobenzene-d4	70-131 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet necessary limits (Section 11.3.4, Page D45/VOC of SOM01.2)	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,2-Dichlorobenzene-d4	70-131 %R
Internal Standards	all samples	50-200% of area, ± 30 sec retention time shift		Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet necessary limits (Section 11.3.4, Page D45/VOC of SOM01.2)	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	50-100% of area, ± 30 sec retention time shift	
Equipment (Field Blank)	1 at the end of drilling	NS		Document in final deliverable with impact to samples	SERAS TL	Accuracy/Bias (Contamination)	<RL	

QAPP Worksheet #28-2
QC Samples Table

Matrix	Aqueous (Groundwater)
Analytical Group	TCL Volatiles
Concentration Level	Trace/Low (ug/L)
Sampling SOP(s)	2001
Analytical Method/SOP Reference	SOM02.2
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Method Blank	1 every 12 hours	No analyte > CRQL*		Suspend analysis unit source recertified	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*	
Matrix Spike (Not Required)	1 per ≤ 20 samples; if requested	1,1-Dichloroethene	61-145 %R	Flag outliers	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene	61-145 %R
		Benzene	76-127 %R				Benzene	76-127 %R
		Trichloroethene	71-120 %R				Trichloroethene	71-120 %R
		Toluene	76-125 %R				Toluene	76-125 %R
		Chlorobenzene	75-130 %R				Chlorobenzene	75-130 %R
Matrix Spike Duplicate (Not Required)	1 per ≤ 20 samples; if requested	1,1-Dichloroethene	0-14 %RPD	Flag outliers	EPA CLP RAS Laboratory GC/MS Technician	Precision	1,1-Dichloroethene	0-14 %RPD
		Benzene	0-11 %RPD				Benzene	0-11 %RPD
		Trichloroethene	0-14 %RPD				Trichloroethene	0-14 %RPD
		Toluene	0-13 %RPD				Toluene	0-13 %RPD
		Chlorobenzene	0-13 %RPD				Chlorobenzene	0-13 %RPD
Deuterated Monitoring Compounds	all samples	Vinyl chloride-d3	65-131 %R	Check calculations and instruments, reanalyze affected samples	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	Vinyl chloride-d3	65-131 %R
		Chloroethane-d5	71-131 %R				Chloroethane-d5	71-131 %R

*with the exception of methylene chloride, 2-butanone and acetone which can be up to 2 times the CRQL, or in some situations may require these compounds be up to 4 times the CRQL.

QAPP Worksheet #28-2
QC Samples Table

Matrix	Aqueous (Groundwater)
Analytical Group	TCL Volatiles Continued
Concentration Level	Trace/Low (ug/L)
Sampling SOP(s)	2007
Analytical Method/SOP Reference	SOM02.2
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Deuterated Monitoring Compounds [cont'd]	all samples	1,1-Dichloroethene-d2	55-104 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet recovery limits	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene-d2	55-104 %R
		2-Butanone-d5	49-155 %R				2-Butanone-d5	49-155 %R
		Chloroform-d	78-121 %R				Chloroform-d	78-121 %R
		1,2-Dichloroethane-d4	78-129 %R				1,2-Dichloroethane-d4	78-129 %R
		Benzene-d6	77-124 %R				Benzene-d6	77-124 %R
		1,2-Dichloropropane-d6	79-124 %R				1,2-Dichloropropane-d6	79-124 %R
		Toluene-d8	77-121 %R				Toluene-d8	77-121 %R
		trans-1,3-Dichloropropene-d4	73-121 %R				trans-1,3-Dichloropropene-d4	73-121 %R
		2-Hexanone-d5	28-135 %R				2-Hexanone-d5	28-135 %R
		1,4-Dioxane-d8	50-150 %R				1,4-Dioxane-d8	50-150 %R
		1,1,2,2-Tetrachloroethane-d2	73-125 %R				1,1,2,2-Tetrachloroethane-d2	73-125 %R

QAPP Worksheet #28-2
QC Samples Table

Matrix	Aqueous (Groundwater)
Analytical Group	TCL Volatiles Continued
Concentration Level	Low (ug/L)
Sampling SOP(s)	2007
Analytical Method/SOP Reference	SOM02.2
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	EPA CLP RAS Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**		**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**	
Deuterated Monitoring Compounds [cont'd]	all samples	1,2-Dichlorobenzene-d4	80-131 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet recovery limits	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	1,2-Dichlorobenzene-d4	80-131 %R
Internal Standards	all samples	60-140%		Check calculations and instruments, reanalyze affected samples	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	± 40 % of response area, ± 20 sec retention time shift	
Equipment (Field Blank)	1 at the end of drilling	NS		Document in final deliverable with impact to samples	SERAS TL	Accuracy/Bias (Contamination)	<RL	

QAPP Worksheet #28-3
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Volatiles
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/8260C
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1 per 20 samples	Within laboratory control chart limits	Flag outliers	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Duplicate	1 per 20 samples	Within laboratory control chart limits	Flag outliers		Precision	Same as Method/SOP QC Acceptance Limits
LCS	1 per 20 samples	Within laboratory control chart limits	Flag outliers or reanalyze		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Internal Standards	all samples	50-100% of area, $\pm$ 30 sec retention time shift	Reanalyze samples to confirm matrix effects		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-3
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Volatiles Continued
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/8260C
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogate Spikes	All samples	Within control chart limits	Reanalyze samples to confirm matrix effects	Laboratory GC/MS Analyst	Accuracy/Bias	Within control chart limits
Method Blank	1 every 12-hours	<RL	Reanalyze, if still out, determine source of contamination and recalibrate and reanalyze	Analyst	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-4
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Semi-Volatiles
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/8270D
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	1 per 20 samples	Within control chart limits	Flag outliers	GC/MS Laboratory Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Duplicate	1 per 20 samples	Within control chart limits	Flag outliers		Precision	Same as Method/SOP QC Acceptance Limits
LCS	1 per 20 samples	Within control chart limits	Flag outliers or reextract		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-4
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Semi-Volatiles Continued
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/8270D
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogate Standards	All samples	Within control chart limits	Check calculations and instruments, reanalyze affected samples	GC/MS Laboratory Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Internal Standards	all samples	50-100% of area, ± 20 sec retention time shift	Check calculations and instruments, reanalyze affected samples		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	1 every 12-hours	<RL	Reanalyze, if still out, determine source of contamination and recalibrate and reanalyze	Analyst	Accuracy/Bias (Contamination)	<RL

QAPP Worksheet #28-5
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Pesticides
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/8081B
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 every 12 hours	< RL	Reanalyze, if still out, determine source of contamination and recalibrate and reanalyze	Laboratory GC/ECD Analyst	Accuracy/Bias	No analyte > RL
Matrix Spike	1 per 20 samples	Within control chart limits	Flag outliers		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Duplicate	1 per 20 samples	Within control chart limits	Flag outliers		Precision	Same as Method/SOP QC Acceptance Limits
LCS	1 per 20 samples	Within control chart limits	Flag outliers; Reextract and reanalyze		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate Standards	all samples	Within control chart limits	Flag outliers		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-6
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Herbicides
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/8151A
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per 20 samples	No analyte > RL	Suspend analysis unit source recertified	Laboratory GC/ECD Analyst	Accuracy/Bias	No analyte > RL
Matrix Spike	1 per 20 samples	Within laboratory control chart limits	Flag outliers		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Matrix Spike Duplicate	1 per 20 samples	Within laboratory control chart limits	Flag outliers		Precision	Same as Method/SOP QC Acceptance Limits
Laboratory Control Sample	1 per 20 samples	Within laboratory control chart limits	Flag outliers; Reextract and reanalyze		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Surrogate	All samples	Within laboratory control chart limits	Flag outliers		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-7
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Metals
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/6010C/7470A
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per 20 samples	<RL	Reanalyze and flag data or re-digest and re-analyze affected samples	ICP-AES/ CVAA Laboratory Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS	1 per 20 samples	75-125%R	Flag outliers		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Laboratory Duplicate	1 per 20 samples	± 20% RPD	Flag outliers		Precision	Same as Method/SOP QC Acceptance Limits
Post-Digestion Spike	After any analyte except Ag or Hg fails spike %R	80-120%R	Flag outliers		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Interference Check Sample	Beginning, after, and periodically during run (2 times every 8 hours)	Within ±2 times CRQL of true value or ±20% of true value, whichever is greater	Check calculations and instruments, re-analyze affected samples		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-7
QC Samples Table

Matrix	Soil (Investigation-Derived Waste)
Analytical Group	TCLP Metals
Concentration Level	Low
Sampling SOP(s)	SERAS SOP 2009
Analytical Method/SOP Reference	EPA 1311/6010C/7470A
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	TBD
No. of Sample Locations	Up to 2

Lab QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Control Sample	1 per $\leq$ 20 samples	80-120%R	Suspend analysis until source rectified; re-digest and re-analyze affected samples		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-8
QC Samples Table

Matrix	Soil
Analytical Group	Chlorinated Solvents
Concentration Level	NA
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	Pace Analytical 2-D CSIA
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	Pace Analytical
No. of Sample Locations	~4

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS_HI	1 per batch of 10	± 1.00 per mil uncertainty	Examine results and QC criteria; if determined to be a result of identifiable interference, narrate else re-analyze.	Analyst	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS_LO	1 per batch of 10	± 1.00 per mil uncertainty	Examine results and QC criteria; if determined to be a result of identifiable interference, narrate else re-analyze.	Analyst	Precision	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #28-8
QC Samples Table

Matrix	Soil
Analytical Group	Chlorinated Solvents
Concentration Level	NA
Sampling SOP	SERAS SOP #2012
Analytical Method/ SOP Reference	Pace Analytical 2-D CSIA
Sampler's Name	Jean Bolduc
Field Sampling Organization	SERAS
Analytical Organization	Pace Analytical
No. of Sample Locations	~4

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Blank	1 per batch of 10	<Method Detection Limit (MDL); if >MDL then area < 1 Vs	Examine results and QC criteria; if determined to be a result of identifiable interference, narrate else re-analyze.	Analyst	Accuracy/Bias Contamination	Same as Method/SOP QC Acceptance Limits
Triplicate Analysis	1 per batch of 10	Standard deviation ≤ ± 0.5%	Examine results and QC criteria; if determined to be a result of identifiable interference, narrate else re-analyze.	Analyst	Precision	Same as Method/SOP QC Acceptance Limits

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-Site Monitoring & Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
COC records Sample Labels Custody Seals Groundwater Sampling Field Sheets Scribe database Field Logbook – GPS, PID, shake test and soil logging data Photodocumentation Field Change Form (if necessary)	Shake test notes and photographs	Instrument run logs Sample extraction logs Sample digestion logs Preventative maintenance logs Instrument printouts Internal COC records Temperature logs Standard receipt logs Standard prep logs Data Reduction/Data Review records Analytical Results	Peer review records Data assessment records ESAT Data Validation Report	Amended Work Plan Revised QAPP Trip Report Scribe Database

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Soil	VOC	Low/Medium	See Worksheet #18	SOM02.2	14 days for preliminary data, 42 days for final data	CLP assigned laboratory	NA
	TOC	NA	See Worksheet #18	EPA Region 2SOP C-83	14 days for preliminary data, 42 days for final data	EPA Region 2 laboratory	NA
	Grain size	NA	See Worksheet #18	EPA Region 2 SOP Bio 8.3	14 days for preliminary data, 42 days for final data	EPA Region 2 laboratory	NA
	CSIA	NA	See Worksheet #18	Chlorinated 2-D CSIA	30 days	CSIA Center of Excellence Pace Analytical 220 William Pitt Way Pittsburgh, PA 15238 Dr. Yi Wang 412-826-3215	NA
Aqueous (Groundwater & IDW)	VOC	Trace/Low	See Worksheet #18	SOM02.2	14 days for preliminary data, 42 days for final data	CLP assigned laboratory	NA
IDW Soil	TCLP VOC	Low	See Worksheet #18	EPA SW-846 Method 1311/8260C	14 days	CLP assigned laboratory	NA
	TCLP SVOC			EPA SW-846 Method 1311/8270D			
	TCLP Pesticides			EPA SW-846 Method 1311/8081			
	TCLP Herbicides			EPA SW-846 Method 1311/8151			

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
	TCLP Metals			EPA SW-846 Method 1311/6010C/ 7470A			

NA = Not applicable

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Laboratory Technical Systems/Performance Audits	NA	External	Regulatory Agency	Regulatory Agency	EPA CLP RAS Laboratory	EPA CLP RAS Laboratory	EPA or other Regulatory Agency
Performance Evaluation Samples	NA	External	Regulatory Agency	Regulatory Agency	EPA CLP RAS Laboratory	EPA CLP RAS Laboratory	EPA or other Regulatory Agency
On-Site Field Inspection	Annual	Internal	EPA	EPA/DESA/HWSS	EPA/DESA/HWSS	EPA/DESA/HWSS	EPA/DESA/HWSS
Proficiency Testing (PT)	Semi-Annual	External	NELAP	PT Provider	EPA Region 2 Lab personnel	EPA Region 2 Lab personnel	EPA Region 2 Lab QA Officer
NELAP	Every 2 years	External	FLDOH	NELAP	EPA Region 2 Lab QA Officer	EPA Region 2 Lab personnel	FLDOH

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Observations/ Deviations from Work Plan	Logbook	Jean Bolduc TL/SERAS	Immediately	Field Change Form	Jean Bolduc/TL - SERAS	Within 24 hours of change
Peer Review	In the deliverable	Jean Bolduc TL/SERAS	Prior to deliverable due date	Comments directly in the deliverable	Jean Bolduc/TL - SERAS	Prior to deliverable due date
Laboratory Technical Systems/Performance Audits	Audit Report	CLP	30 days	Letter	CLP	14 days
Performance Evaluation Samples	Electronic Report	CLP Laboratory	30 days	Letter or written report	CLP Laboratory	14 days
PT	Letter with PT failure indicated	Lab QA Officer	30 days after audit	Letter	Lab QA Officer	45 days after Corrective Action Report
NELAC	Audit Report	Lab Management	30 days after audit	Letter or written report	Lab QA Officer	30 days after receiving notification

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Technical Report	Monthly	20th of the month following performance period	TL/SERAS	ERT Project Officer and WAM
QA Report	Quarterly	February, May, August, November	Deborah Killeen, QA/QC Officer/SERAS	ERT Project Officer and Quality Coordinator

QAPP Worksheet #34
Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Completeness Check	Review of planning documents, analytical data package, sampling documents and external reports, as applicable, using the UFP-QAPP checklist	Internal	SERAS TL
Laboratory analytical data package	Data packages will be reviewed/verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	External	CLP Laboratory EPA Region 2 DESA Laboratory Pace Analytical
	Reviewed for measurement performance criteria	External	ESAT Data Validation Team
Trip Report	Deliverable will be reviewed to verify transcription errors are not present	Internal	SERAS peer review team

QAPP Worksheet #35
Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in the QAPP were followed and any deviations noted	SERAS TL, WAM
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	ESAT Data Validation Personnel, EPA Region 2, ERT WAM
IIa	Chains of custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	CLP Analysts, ESAT Data Validation Personnel, EPA Region 2 SERAS TL
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	CLP Analysts, ESAT Data Validation Personnel, EPA Region 2
IIb	Laboratory data package	Determine potential impacts from noted/approved deviations, in regard to PQOs. Examples include PQLs and QC sample limits (precision/accuracy).	ESAT Data Validation Personnel, EPA Region 2
IIb	Field duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	SERAS TL ERT WAM

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa/IIb	Soil/Groundwater	VOC	Low/Medium	SOP #HW-33, *Low/Medium Volatile Data Validation,* Revision 3	ESAT Data Validation Personnel, EPA Region 2 Data Validation Personnel
IIa/IIb	Groundwater	VOC	Trace	SOP #HW-34, *Trace Volatile Data Validation*	ESAT Data Validation Personnel, EPA Region 2 Data Validation Personnel

http://pubweb.epa.gov/region2/qa/documents.htm

☑ Worksheet Not Applicable (State Reason) EPA Region 2 will be responsible for assessing the usability of the data.

QAPP Worksheet #37
Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
Describe the evaluative procedures used to assess overall measurement error associated with the project:
Identify the personnel responsible for performing the usability assessment: Region 2
Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

FIGURES
Potential Sample Collection Points (Cedarwood & Piermont Cleaners)
Peninsula Boulevard UFP-QAPP
November 2015

Map created using 2010 orthoimagery data from NY state,

Map Creation Date: 24 September 2015

Coordinate system: State Plane New York Long Island
FIPS: 3104
Datum: NAD83
Units: Feet

0 60 120
Feet

Data: g:\arcviewprojects\SERAS01\00-149
MXD file: g:\arcinfoprojects\SERAS01\SER00149_Peninsula_BLVD\149_RFP_PotentialSampleCollectionPoints_atCedarwoodUpgradiant_f1

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-149

Figure 1
Potential Sample Collection Points
Cedarwood Cleaners Site
and Upgradient Property
Peninsula Boulevard Site
Hewlett, New York

Map created using 2010 orthoimagery data from NY state,

Map Creation Date: 24 September 2015

Coordinate system: State Plane New York Long Island
FIPS: 3104
Datum: NAD83
Units: Feet

0 36 72
Feet

Data: g:\arcviewprojects\SERAS01\00-149
MXD file: g:\arcinfoprojects\SERAS01\SER00149_Peninsula_BLVD\149_RFP_PotentialSampleCollectionPoints_atPiermontCleanersSite_f2

U.S. EPA Environmental Response Team
Scientific Engineering Response and Analytical Services
EP-W-09-031
W.A.# 0-149

Figure 2
Potential Sample Collection Points
Piermont Cleaners Site
Peninsula Boulevard Site
Hewlett, New York

APPENDIX A
Chlorinated Solvents for CSIA (Waters)
UFP-QAPP for Peninsula Boulevard
November 2015

Standard Operating Procedures

Chlorinated Solvents for Compound-Specific Isotope Analysis

Yi Wang, PhD

Director, ZymaX Forensics Isotope Laboratory, Escondido, CA 92029-1917
Phone: 760-781-3338 ext 43, Email: yi.wang@zymaxusa.com

Compound-Specific Isotope Analysis (CSIA) technique can variously be used to measure the isotopic composition of many types of contaminants, and CSIA has been applied to study the sources and behavior of subsurface contaminants, including chlorinated solvents, BTEX, PAHs, crude oil and its refined hydrocarbon products.

U.S. EPA published a Report in December 2008: A Guide for Assessing Biodegradation and Source Identification of Organic Ground Water Contaminants using Compound-Specific Isotope Analysis (http://www.epa.gov/ada/pubs/reports/600r08148/600r08148.pdf). It provides recommendations for sample collection, sample preservation, and sample analysis; recommendations on QA/QC issues; details on calculations; and a catalogue of expected initial values for the ratios of ^{13}C to ^{12}C in organic compounds such as TCE and PCE. The Guide also illustrates in detail the process to use isotope ratio data to estimate rate constants for degradation of organic compounds in ground water.

Dr. John T. Wilson at U.S. EPA gave a series of webinar "Application of Stable Isotope Analyses to Understand the Degradation of Organic Contaminants in Ground Water" in 2010 (http://www.clu-in.org/conf/tio/stableisotope_061610/). These webinars reviewed the theory behind isotopic effects, explained the units used to characterize the ratio of isotopes, and discussed the mathematics that can relate the shift in the ratio to the extent of degradation. A number of cautions and warnings were also given on the application of CSIA.

At ZymaX Forensic Isotope Laboratory, chlorinated solvent samples are analyzed according to the U.S. EPA's Guide (2008) and Dr. Wilson's Presentation (2010). Standard operating procedures (SOP) including QA/QC procedures on how to perform CISA at ZymaX Forensics Isotope Laboratory have been prepared as follows:

Sample Collection for CSIA

1. Samples are collected for CSIA in the same manner of samples collected for the volatile organic contaminant analysis by EPA method 8260B. Chlorinated solvents in groundwater are collected into 40mL VOA vials, which are pre-cleaned and HCl preserved, leaving zero headspace. Sample containers are provided free of charge upon ZymaX Forensic clients' request.
2. Eight replicates are prepared for each sample therefore both VOCs and isotopic analysis can be performed at the same time. Samples are kept at ~4°C in the dark and shipped overnight on ice to the lab.
3. Holding time for the VOCs test is 14 days defined by the US EPA. For CSIA it is safer to adapt the same 14 days or 30 days (currently there is no clear requirement from US EPA on the holding time of CSIA), since there is no sufficient evidence that samples being held for more than one month are still safe for the CSIA.
4. Promised standard turnaround time for CSIA forensics at ZymaX Forensics Isotope Laboratory is 30 days, further, rush services (14 days) are available upon request, which incur additional charge.

Compound Specific Isotope Analyses

1. Upon receipt of samples, ZymaX Forensics Isotope Laboratory will have the samples logged into its LIMS system, issuing a project number and a laboratory work order. Samples will be kept at ~4°C in the dark until CSIA. Two VOA vials for each sample will be shipped overnight on ice to our subcontract lab for their VOA test (7 day TAT).
2. Chlorinated solvents are extracted from water samples on a solid Phase Micro Extraction (SPME) fiber. The SPME fiber is placed in the headspace of a vial above 35 mL of the water sample, which is stirred for 30 min to achieve equilibrium of the volatile compounds between water and headspace.
3. The SPME fiber is inserted into the injection port of an Agilent 6890 GC linked to an oxidation furnace and a Micromass IsoPrime Isotope Ratio Mass Spectrometer (IRMS). Volatile compounds are desorbed from the SPME fiber at high temperature in the GC injection port into a helium carrier gas flow. Compounds such as PCE, TCE, and *cis*-DCE, etc., are separated on the GC column, flushed in the carrier gas through the furnace to convert the carbon in each compound to CO_2 and the carbon isotope ratio of the CO_2 measured in the IRMS.
4. Three pulses of a reference CO_2 gas with known isotope composition are injected at the beginning of each sample run. The IsoPrime software routinely uses the second gas reference peak as the reference to calculate isotope ratios for the other peak, including those of the gas reference peaks.

5. Stable isotope ratios are conventionally referenced to an internationally recognized standard, and are expressed in the δ notation, for carbon,

$$\delta^{13}C = (R_{sample}/R_{standard} -1) \times 1000, \text{ and } R = {}^{13}C/{}^{12}C$$

Units are per mil (‰). The standard, by definition, has a δ value of 0, and samples may have positive or negative δ values depending on whether the sample is enriched or depleted in the heavier isotope. The international standard for carbon is Pee Dee Belemnite (PDB).

6. Every fifth sample is used as a sample replicate. Every tenth sample is the compound specific working standard.
7. True values of each compound specific working standard are reported, together with the values determined for these standards during the analysis of the sample, which should fall within the acceptable range of determined values from the true value for the compound specific working standards (±0.5‰).
8. The method to prepare the sample for analysis will fractionate the sample, so the measured isotope values are to be corrected for the fractionation during preparation before they are reported.
9. The precision of isotope analysis are to be determined based on triplicate analysis of the compound specific working standards. Standard deviation should be equal to or less than ±0.5‰ for carbon.
10. Method detection limit (MDL) for CSIA is defined as the signal size below which the standard deviation of the mean exceeds 0.5‰ and the $\delta^{13}C$ values are outside the 0.5‰ interval around the running mean. Typically MDL varies between 10 and 20 µg/L for different chlorinated solvent components in water sample. Values of replicate analyses (n=3) of the compound specific working standard at MDL are to be reported.
11. In most plumes of chlorinated solvents, there are usually few VOA compounds in the water, and peaks of individual compounds are clearly separated from each other. The detection of suspect co-elution is performed by checking chromatogram for each ratio trace (45/44) of each target peak, or more generally, any differences in the peak shape of ratio trace as compared to the standard. Additional run with a modified GC program may apply to improve the separation of peaks if severe co-elution is observed.

APPENDIX B
Chlorinated Solvents for CSIA (Soil/Sediment)
UFP-QAPP for Peninsula Boulevard
November 2015

Chlorinated Solvent Compound-Specific Isotope Analysis Soil/Sediment Standard Operating Procedure

Yi Wang, PhD

Director, CSIA Center of Excellence, Pace Analytical
220 William Pitt Way
Pittsburgh, PA 15238
Yi.Wang@zymaxusa.com
609.721.2843

Compound-Specific Isotope Analysis (CSIA) techniques can be used to measure the isotopic composition of many types of contaminants; CSIA has been applied to study the sources and behavior of subsurface contaminants, including chlorinated solvents, BTEX, PAHs, crude oil and its refined hydrocarbon products.

U.S. EPA published a Report in December 2008: A Guide for Assessing Biodegradation and Source Identification of Organic Ground Water Contaminants using Compound-Specific Isotope Analysis (http://www.epa.gov/ada/pubs/reports/600r08148/600r08148.pdf). It provides recommendations for sample collection, sample preservation, and sample analysis; recommendations on QA/QC issues; details on calculations; and a catalogue of expected initial values for the ratios of ^{13}C to ^{12}C in organic compounds such as TCE and PCE. The Guide also illustrates in detail the process to use isotope ratio data to estimate rate constants for degradation of organic compounds in ground water.

Dr. John T. Wilson, formerly of U.S. EPA gave a series of webinars on "Application of Stable Isotope Analyses to Understand the Degradation of Organic Contaminants in Ground Water" in 2010 (See http://www.cluin.org/conf/tio/stableisotope_061610/). These webinars reviewed the theory behind isotopic effects, explained the units used to characterize the ratio of isotopes, and discussed the mathematics that can relate the shift in the ratio to the extent of degradation. A number of cautions and warnings were also given on the application of CSIA.

At Pace Analytical (formerly ZymaX Forensic Isotope Laboratory), chlorinated solvent samples are analyzed in accordance with methods included in the U.S. EPA's Guide (2008) and Dr. Wilson's Presentation (2010). The Standard Operating Procedures (SOP); including QA/QC on how to perform CSIA at the Pace Analytical Laboratory have been prepared as follows:

Sample Collection for CSIA

Samples are collected for CSIA in the same manner as for volatile organic contaminant (VOC) analysis by EPA Method 5035A, solid sample extraction for VOCs testing, summarized here and full text available at http://www.epa.gov/osw/hazard/testmethods/pdfs/5035a_r1.pdf.

Sample collection is done in accordance with procedures outlined in the project-specific sampling plan. As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample to minimize the loss of volatiles.

It is recommended that VOC solid samples be collected maintaining a closed-system approach, using an appropriate coring device and be immediately transferred to the VOA vial/jar to be used for analysis and stored no longer than 48 hours at 4 ± 2°C prior to analysis or preservation.

Chlorinated solvents sample collection from soil or sediment is done according to the VOC expected concentrations.

Low concentration soil/sediment sampling

For low concentration soil/sediment samples, using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil/sediment or other solid material has been disturbed.

Carefully wipe the exterior of the sample collection device with a clean cloth or towel. Using the sample collection device, add 5 g (2-3 cm) of soil to the sample vial/jars as discussed in Appendix A of EPA Method 5035A, attached. Quickly brush any soil off the vial threads and seal the vial with the septum and screw-cap. Store samples on ice at 4°C and ship to the laboratory as outlined in Appendix A.

Collect at least two replicate samples. This will allow an additional sample for reanalysis, if needed. The second sample should be taken from the same soil stratum or section of the solid material being sampled, within close proximity to the location of the original sample. At least one additional aliquot of sample must be collected for screening, moisture determination, and high concentration analysis (if necessary).

If samples are known or expected to contain target analytes over a wide range of concentrations, requiring the analyses of multiple sample aliquots, take an additional sample aliquot in a low concentration soil vial/jar containing the preservative, collecting only 1-2 g. This aliquot may be used for those analytes that exceed the instrument calibration range in the 5-g analysis.

High concentration soil/sediment sampling

For high concentration soil/sediment samples, using an appropriate sample collection device, collect the material as soon as possible after the surface of the soil/sediment or other solid material has been disturbed.

Carefully wipe the exterior of the sample collection device with a clean cloth or towel. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C and ship to the laboratory as outlined in Appendix A.

For high concentration samples not preserved in the field (e.g., wastes containing percent level concentrations), that are not preserved in the field follow similar procedures as for other types of samples, except that the sample vials/jars contain neither the aqueous preservative solution or methanol. When field preservation is not used, it is better to collect a larger volume sample, filling the sample container as full as practical in order to minimize the headspace. This generally does not require the collection of a separate aliquot for moisture determination; however, it may be advisable to collect a second sample aliquot for screening purposes, in order to minimize the loss of volatiles in either aliquot.

Pace provides appropriate containers, which include, for solid samples, two 4 oz. wide mouth glass jars with Teflon-lined closure. Some systems employ 40-mL clear vials with a special frit and two PTFE-faced silicone septa, others can use any good quality glass vial large enough to hold 5 g of soil or solid material and at least 10 mL of water, that can be sealed with a screw-cap containing a PTFE-faced silicone septum. Additional information on sample containers can be found in Appendix A, Sections 1.6, 3.0, 6.2, 7.0 and 8.0 of Method 5035A.

For collection of soil samples, fill two jars for each sample, avoiding loss of volatiles. Store samples at <4°C in the dark and ship overnight to the laboratory as outlined in Appendix A.

Samples should be screened to avoid contamination of the purge-and-trap system by samples that contain very high concentrations above the calibration range of the low concentration method. Because the sealed sample container cannot be opened to remove a sample aliquot without compromising the integrity of the sample, multiple sample aliquots should be collected to allow for screening and reanalysis.

The low concentration soil method utilizes the same 4 ~~oz~~oz. jars, with the seal remaining unbroken from the time of sampling to the time of analysis to minimize the loss of VOCs during transport, handling, and analysis. The applicable concentration range of the low soil method generally falls in the 0.5 to 200 µg/kg range. The closed-system purge-and-trap equipment employed for low concentration samples is not appropriate for soil samples preserved in the field with methanol. Refer to Appendix A of Method EPA 5035A for additional information.

Laboratory Analysis

Holding time for the VOCs test is 14 days defined by the US EPA. For CSIA it is safer to adapt the same 14 days.

Upon receipt of samples, Pace CSIA Laboratory will have the samples logged into its LIMS system, issuing a project number and a laboratory work order. Samples will be kept at ~4°C in the dark until CSIA is performed. Two 4 ~~oz~~oz. jars for each sample will be shipped overnight on ice to subcontract lab for their VOA test (7 day TAT).

Chlorinated solvents are extracted from solid samples on a solid Phase Micro Extraction (SPME) fiber. The SPME fiber is placed in the headspace of a vial above 35 mL of the water sample, which is stirred for 30 min to achieve equilibrium of the volatile compounds between water and headspace.

The SPME fiber is inserted into the injection port of an Agilent 6890 GC linked to an oxidation furnace and a Micromass IsoPrime Isotope Ratio Mass Spectrometer (IRMS). Volatile compounds are desorbed from the SPME fiber at high temperature in the GC injection port into a helium carrier gas flow. Compounds such as PCE, TCE, and *cis*-DCE, etc., are separated on the GC column, flushed in the carrier gas through the furnace to convert the carbon in each compound to CO_2 and the carbon isotope ratio of the CO_2 measured in the IRMS.

Three pulses of a reference CO_2 gas with known isotope composition are injected at the beginning of each sample run. The IsoPrime software routinely uses the second gas reference peak as the reference to calculate isotope ratios for the other peak, including those of the gas reference peaks.

Stable isotope ratios are conventionally referenced to an internationally recognized standard, and are expressed in the notation, for carbon, $_{13}C = (R_{sample}/R_{standard} - 1) \times 1000$, and $R = {}_{13}C/{}_{12}C$ Units are per mil (‰). The standard, by definition, has a value of 0, and samples may have positive or negative values depending on whether the sample is enriched or depleted in the heavier isotope. The international standard for carbon is Pee Dee Belemnite (PDB).

Every fifth sample is used as a sample replicate. Every tenth sample is the compound specific working standard.

True values of each compound specific working standard are reported, together with the values determined for these standards during the analysis of the sample, which should fall within the acceptable range of determined values from the true value for the compound specific working standards (±0.5‰).

The method to prepare the sample for analysis will fractionate the sample, so the measured isotope values are to be corrected for the fractionation during preparation before they are reported.

The precision of isotope analysis are to be determined based on triplicate analysis of the compound specific working standards. Standard deviation should be equal to or less than ±0.5‰ for carbon.

Method detection limit (MDL) for CSIA is defined as the signal size below which the standard deviation of the mean exceeds 0.5‰ and the $_{13}C$ values are outside the 0.5‰ interval around the running mean. Typically MDL varies between 25 and 50 µg/kg for different chlorinated solvent components in soil sample. Values of replicate analyses (n=3) of the compound specific working standard at MDL are to be reported.

In most soil and sediment samples impacted by chlorinated solvents, there are few VOA compounds in the samples collected, and peaks of individual compounds are clearly separated from each other. The detection of suspect co-elution is performed by checking chromatogram for each ratio trace (45/44) of each target peak, or more generally, any differences in the peak shape of ratio trace as compared to the standard. Additional run with a modified GC program may apply to improve the separation of peaks if severe co-elution is observed.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 12/10/15	**Time:** 0800	**Location:** Peninsula Blvd
Work Assignment #: 149	**Person Initiating Change:** Jan Boldue	
Work Assignment Title: Peninsula Blvd		
Original Scope Being Changed (e.g., Work Assignment requests 5 samples): Locations of CSIA samples.		
Changed Scope (e.g., WAM requests 30 samples): More western transect selected for CSIA sample collection locations.		
Reason for Changed Scope: Original locations were uncertain due to discrepancies in electronic map.		
Task Leader Signature/Date: JMB 12/10/15		
Work Assignment Manager Signature/Date:		
Other Applicable Signature(s)/Date:		

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 12/10/15	Time: 0800	Location: Peninsula Blvd
Work Assignment #: 149		**Person Initiating Change:** Jean Boldre

Work Assignment Title: Peninsula Blvd

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):
Aqueous Rinsate Blank collection of 0 to 1 samples (end of sampling)

Changed Scope (e.g., WAM requests 30 samples):
Aqueous rinsate blank collection if requested end of sampling

Reason for Changed Scope:
WAM requested due to non-detected soil samples

Task Leader Signature/Date:
JmB 12/10/15

Work Assignment Manager Signature/Date:

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 12/17/15	Time: 0920	Location: Hewlett, NY
Work Assignment #: 149		Person Initiating Change: Jean Boldue

Work Assignment Title: Peninsula Blvd site

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

TCLP data is screening data.

Changed Scope (e.g., WAM requests 30 samples):

TCLP data is definitive data.

Reason for Changed Scope:

TCLP data is generated by CLP laboratory and is automatically validated.

Task Leader Signature/Date: Jean Boldue

Work Assignment Manager Signature/Date: 12/17/15

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 12/17/15	**Time:** 0920	**Location:** Hewlett, NY
Work Assignment #: 149	**Person Initiating Change:** Jean Boldue	
Work Assignment Title: Peninsula Blvd Site.		
Original Scope Being Changed (e.g., Work Assignment requests 5 samples): IDW soil characterization samples being analyzed by EPA/SW-846 8270C		
Changed Scope (e.g., WAM requests 30 samples): IDW soil characterization samples being analyzed by SOM023		
Reason for Changed Scope: CLP assigned ~~lab~~ VB laboratory is analyzing the IDW soil samples.		
Task Leader Signature/Date: Tm BC		
Work Assignment Manager Signature/Date: 12/17/15		
Other Applicable Signature(s)/Date:		

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 1/21/16	**Time:** 0900	**Location:** Howe th, NY
Work Assignment #: 149	**Person Initiating Change:** Josh Boldue	
Work Assignment Title: Peninsula Blvd		

Original Scope Being Changed (e.g., Work Assignment requests 5 samples):

Adding aqueous sample analyses for frac tank. Also adding total VOCs analysis for waste soil.

Changed Scope (e.g., WAM requests 30 samples):

Aqueous sample from frac tank to be analyzed for VOCs, pesticides, PCBs, total metals and SVOCs; soil sample from roll off bin for VOCs.

Reason for Changed Scope:

Need to characterize frac tank water for onsite disposal/treatment and roll off bin soil for offsite disposal.

Task Leader Signature/Date:

JRB 1/21/16

Work Assignment Manager Signature/Date:

1/21/16

Other Applicable Signature(s)/Date:

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 2/19/16	**Time:** 0700	**Location:** Edison, NJ
Work Assignment #: WA-149	**Person Initiating Change:** Jeff Bolden	
Work Assignment Title:		
Original Scope Being Changed (e.g., Work Assignment requests 5 samples): Groundwater samples were not going to be analyzed for CSIA, only soil samples were to be analyzed for CSIA.		
Changed Scope (e.g., WAM requests 30 samples): Jon Gabry will select 4-6 monitor well locations to be sampled for groundwater CSIA analysis.		
Reason for Changed Scope: Groundwater CSIA data will be used to supplement soil CSIA data to identify potential sources of chlorinated solvents.		
Task Leader Signature/Date: JmB 2/19/16		
Work Assignment Manager Signature/Date: 2/19/16		
Other Applicable Signature(s)/Date:		

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: 2/19/16	**Time:** 0700	**Location:** Edison, NJ
Work Assignment #: WA-149	**Person Initiating Change:** Jean Boldue	
Work Assignment Title: Peninsula Boulevard Site		
Original Scope Being Changed (e.g., Work Assignment requests 5 samples): Groundwater samples being analyzed for VOCs by CLP laboratory.		
Changed Scope (e.g., WAM requests 30 samples): Groundwater samples being analyzed for VOCs by Region 2 laboratory.		
Reason for Changed Scope: Fast turn-around time on analysis resulted in samples being scheduled for delivery to Region 2 instead of CLP lab.		
Task Leader Signature/Date: JMB 2/19/16		
Work Assignment Manager Signature/Date: 2/19/16		
Other Applicable Signature(s)/Date:		

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.

SERAS Work Assignment Field Change Form

(must be completed to initiate any on-site change in the scope of a Work Assignment)

Date: April 1, 2016	**Time: 0925**	**Location: Edison, NJ**
Work Assignment #: 149	**Person Initiating Change: Jean Bolduc, Task Lead**	
Work Assignment Title: Peninsula Boulevard Site		
Original Scope Being Changed (e.g., Work Assignment requests 5 samples): **Two- and three-dimensional (2D & 3D) presentation of tetrachloroethene (PCE) and trichloroethene (TCE) data for soil and groundwater using Mining Visualization Software (MVS) operated by an outside vendor located in Missoula, MT under the supervision of Lockheed Martin SERAS.**		
Changed Scope (e.g., WAM requests 30 samples): **West Central Environmental Consultants, Inc. will prepare 2D/3D plan view maps and 2D cross sections from an MVS model of the data collected at the Peninsula Boulevard Site under EPA-approved QAPPS (original through Revision 6) and data quality objectives (DQOs) generated for this WA. The following data will be included in the model: ground surface elevations, groundwater levels, borehole and monitoring well location coordinates, total depths of the boreholes and monitoring wells, depths to bottom of the geologic layers encountered in the boreholes, soil and groundwater sample depths, and PCE/TCE concentrations for soil and groundwater samples. Additional data not listed in this Changed Scope or collected under EPA-approved QAPPs/DQOs for the Site will not be used in the model.**		
Reason for Changed Scope: MVS modeling was not included in the last QAPP revision. However, an MVS model can be quickly constructed by an experienced operator and provides a cost effective method for presenting 2D and 3D visualizations of the large database of geologic, hydrogeologic and analytical data compiled for this Site.		
Task Leader Signature/Date: TJB 04/01/2016		
Work Assignment Manager Signature/Date: 4/1/2016		

SERAS Work Assignment Field Change Form

Other Applicable Signature(s)/Date:

OSRTI QA MANAGER

cc: EPA Work Assignment Manager
Kevin Taylor, SERAS Program Manager
Deborah Killeen, SERAS QA/QC Officer
Richard Leuser, Deputy Program Manager

Please note: 1) Additional resources (hours and/or dollars) may be required to fulfill the requested change in scope, 2) the schedule and milestones for this project as well as other projects may be modified as a result of the requested change in scope, and 3) these requirements/changes will be communicated in writing to the WAM as soon as a resource evaluation is made.